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COCONUT CULTIVATION IN THE EASTERN PROVINCE.

The rainfall of Batticaloa, the centre of the coconut growing industry of the Eastern Province, has averaged for the last 44 years 62·83 inches per annum. Some 50 inches of this total fall in the five months October-February during the North-East Monsoon; so that while the rain is sufficient in quantity the distribution is so uneven that the trees bear only half crops. It is worth while calculating the amount of water lost during the year, and whether and by what means any of it could be saved.

The trees are planted at the rate of 80 to the acre, and yield on an average 25 nuts per tree per annum. This gives 2,000 nuts per acre. It takes at Batticaloa 1,100 nuts to make a candy of copra (560 lb.), so that the average weight of copra produced is 9 cwt. Taking into account the husks, shells and fallen leaves, we shall probably not be far wrong in estimating the amount of dry matter produced in the course of the year at 36 cwt. The amount of water transpired by a plant for one pound of dry matter produced depends upon several factors—species, fertility of soil, temperature and humidity of atmosphere. Generally speaking it may be taken as 500 lb. It is probably much more than this with the hot dry climate and poor soils of Batticaloa; not less than 800 lb. Calculating it at 800* we find that

* The writer in his address at Batticaloa on October 9th, of which this article is a summary, took the amount at 1,000, which may perhaps be a little high.

1,440 tons of water per acre per annum are used by the coconut trees to produce their crop. A fall of 62·83 inches represents 6,408 tons of water ; 4,968 tons are therefore lost.

Some of this drains away in the monsoon flood but the bulk of it sinks in, raising the water table. Of that which sinks a great proportion is eventually dissipated through surface evaporation and transpiration by weeds. Surface evaporation can be checked by stirring the surface of the land from time to time to rupture the capillary tubes through which water rises by attraction from the water table. If these tubes are broken by harrows the water cannot escape at the surface but must needs pass through the trees. The amount of copra produced being in direct proportion to the amount of water transpired, the planter possesses in the harrow means whereby to increase his crops. Again, clean weeding is one of the fundamental principles of the Dry-farmer, because weeds transpire soil moisture just as the crops themselves do. The water escapes through weeds at a much greater rate than through a bare, uncultivated surface. Under conditions such as prevail at Batticaloa, where all the energies of the coconut planter should be concentrated upon husbanding his soil-water, not a weed or bush should be allowed to grow in a bearing plantation during the dry weather. In a young plantation the circumstances are a little different ; the young trees do not occupy all the land ; green manures could therefore with advantage be grown between the rows and cut and mulched to the plants. If by disc-harrowing his land, say, once a month and clean weeding he could save one-seventh part of the water now lost, the planter might reasonably expect to increase his crop 50 per cent.

The soils of Batticaloa are sandy, very suitable, it has been pointed out, for coconut trees ; but the suitability of a soil for a particular crop can never be considered wholly apart from climate. If the 62 inches of rain fell half in the South-West Monsoon and half in the North-East the soil might be considered very suitable for coconut trees, but sandy soils are not adapted for retaining moisture through a long period of dry weather. The Batticaloa soils lack body; they require organic matter in the form of coconut husks, dead leaves, branches; as much as can

possibly be applied to them. This would improve their texture and increase their power of retaining moisture. It would also increase their fertility, as organic matter is the source of nitrogen. The amount of water transpired for a pound of dry matter produced is less in a fertile than in a poor soil. Coconut husks, jungle mulch and green manures can therefore to a certain extent take the place of water. At present husks are in nearly every case burnt, a squandering of wealth deplorable under the circumstances. By some means or other they should be returned to the land to rot into the soil. Burying them in trenches no doubt hastens their decomposition, but the trenches unless filled up immediately operate as drains, the very thing to avoid in the dry season. Scattering them loosely over the land before the rains set in would probably be the most satisfactory for the soil. It is a point, however, that only local experience and circumstances can decide.

But we believe that something more than the returning of the husks could profitably be undertaken on these porous soils, which require above all things organic matter to give them body and to enrich their store of plant food. Jungle mulch where available and near at hand could be carted on to the land; and young plantations could be thickly sown with green manures suitable to the soil. Divi-divi appears to be such a one. It belongs to the natural order leguminosæ which has the property of collecting nitrogen from the atmosphere, thus adding greatly to the food supply of the soil when their leaves and branches are cut and mulched, and it grows freely at Batticaloa. The question of how best to cultivate them as a green manure to occupy the land for only 5 or 6 years is one that the local Agricultural Society should take up on their new experiment station when it is opened. Thick sowing (say in rows 3 feet apart) and frequent cutting back would be the lines to follow. Pigeon pea *(Cajanus indicus)* should also be tried as well as other green manures such as horse gram *(Dolichos)*, black and green gram *(Phaseolus)*, cowpea *(Vigna)*, jack beans *(Canavalia)*, velvet beans *(Stizolobium)*; not only in young plantations but also among large trees, provided the green crops were ploughed or harrowed into the soil before the dry weather set in.

R. N. L.

COCONUTS.

COCONUTS AT ST. LUCIA.

A considerable amount of attention has been paid to coconut cultivation during the last few years, and the extension has increased at such a rate that coconut planting can no longer be regarded as a minor industry in St. Lucia. Many of the older plantations will soon be coming into bearing, and the various questions connected with the preparation of marketable copra, etc., will require investigation.

The soils of St. Lucia and the local climatic conditions are most suitable for this cultivation, and the majority of the young groves give every promise of a flourishing industry being established in the near future.

The export of coconuts shows a decrease of 16,459 nuts on the previous year. This decrease can be explained satisfactorily from a local and agricultural standpoint, as there has been no falling-off in production but really an annual increase of something between 25,000 to 30,000 nuts. These nuts have been used for local planting, and allowing for losses, represents an increase in this cultivation of something like 450 acres.

In future it is likely that there will be a steady increase in the shipping of copra, as the majority of planters are fully alive to the importance of selecting only the best nuts for planting, the smaller ones being dried and shipped as copra. The increase in this export for the year under review was 73 cwt.—REPT. OF THE AGRIC. DEPT., 1914-15.

SELECTION OF COCONUTS FOR GERMINATION.

This article discusses the question of the effect of the age of the tree and its local conditions on the quality of the nuts for seed purposes. No evidence is obtainable to support the view that the nuts of young trees are unsuitable for seed purposes, and it is considered sufficient to select nuts for planting purposes from trees in their third or fourth year of bearing. In this way a more complete pedigree, so essential to seed selection, is obtained.

Trees from selected nuts planted in Nevis (West Indies), came into bearing at 4 years and 4 months and out of 1,000 nuts selected a year later, more than 89 per cent. germinated.—BULL. OF THE INTERNATIONAL INST. OF AGRIC.

COCONUTS IN PORTO RICO.

The coconut co-operative experiments, including fertilization and culture, reported on the past two years, have been continued and new cultural experiments undertaken in parts of the island where different weather conditions prevail. As this is a profitable crop, and one to which but little experimental attention has been given in Porto Rico, it is the plan to extend the lines of work already undertaken, including fertilization, seed-nut selection, and nursery and orchard culture. In the fertilization experiments started in June, 1912, eight harvests have been made The number of nuts taken from each tree and the diameter of the nuts from the different plats have been recorded for each harvest. The yield in the plats given complete fertilizer was in excess of that in check plats for the last harvest, although between the complete and incomplete and check plats but little differences have resulted so far. The number of nuts harvested in the experimental field hardly averaged 30 per tree. The average diameter of the nuts was 4·8 inches. As the trees under observation are old palms on sandy beach land, apparently an ideal situation for coconut culture, the results of the harvests show how slowly old palms give returns for fertilizer investment. As the yield per tree is far below what it should be, an early increase is expected in the fertilizer plats.

Aside from the notes on fertilization, valuable data have been recorded regarding the number of nuts harvested from the individual trees. A few trees are bearing over 100 nuts per year, exceptional ones over 140, while a number, which are from all appearance thrifty, are producing annually not more than 10 nuts each, and a few not more than 5 nuts each. As there is a good stand of trees in the experimental plats, and productive and unproductive ones are found growing side by side throughout the field, the importance of seed-nut selection by those contemplating a new grove is plainly shown. In connection with selection work, records are being made showing the constancy in shape and size of both husks and nuts borne by individual trees.

In co-operation with A. J. HARVEY, experiments are being conducted on his plantation to determine the advisability of growing leguminous cover crops in a young coconut grove. This plantation is situated a few miles east of San Juan on a sandy coastal plain within half a mile of the ocean. Jack beans (*Canavalia ensiformis*) and a few species of velvet beans (*Stizolobium* spp.) planted in April all made good growth ; and as they crowded out all native weeds and grass, cultivation was dispensed with, except for cutting the leguminous vines near the palms every few weeks, until the plants died in the following winter. The *Stizolobium* species proved to have a longer growing season and to produce a heavier crop of vegetation than the Canavalia, and are, therefore, preferable in coconut plantations. The type of land suitable to coconut culture, if not cultivated, will, for most of the year, be overgrown with wild vines and weeds. These wild vines are almost as troublesome as

the *Stizolobiums* in climbing over the young trees, and they store no nitrogen from the air and add much less vegetable matter to the soil. Coconut palms should be set further apart than other orchard trees, and the cultivation of this large area and the improvement of the soil can be greatly facilitated by the judicious use of leguminous cover crops.—REPT. OF PORTO RICO AGRIC. EXPT. STN., 1914.

COCONUT POONAC.

The following analysis of coconut poonac recently made in the Bangalore Laboratory appears in the PLANTERS' CHRONICLE :—

Moisture	12·89
Organic Matter*	78·09
Phosphoric acid	1·47
Potash	1·89
Other soluble mineral matter	3·05
Insoluble mineral matter	2·61

SANDALWOOD TREE.

The following interesting note on this tree occurs in the report of the Superintendent, Madras Agri-Horticultural Society's Gardens :—*Santalum album*, known as the Sandalwood Tree, is a native of the Mysore State where the wood is a Government monopoly and brings in a very large income as the bulk of the 2,000 tons annually offered for sale comes from Mysore. Frequently members and customers of this Society have asked for sandalwood seedlings and I have procured them from Mysore, or grown them from seed in the gardens, but the majority of the plants have died and it has always been put down to defective re-potting and hurting the roots; but it has recently come to my notice that the plant is a root-parasite obtaining a great deal of its nourishment from the roots of other trees, so that in transplanting sandalwood tree seedlings a very large ball of earth attached to the roots must be taken up in addition to being careful not to hurt the tap root and in planting the tree it should be placed where the roots can attach themselves to the roots of shrubs growing near by. Most trees object to and suffer from the tangling of the roots of other trees and shrubs, but in the case of the Sandalwood tree such a tangle is necessary to its parasitic root system.

* Nitrogen in organic matter ... ... 3·50

RUBBER.

RUBBER FAMINE IN GERMANY.

When the war broke out German business circles recognized that the extraordinary conditions it created would have a far-reaching effect on the commercial and industrial life of the empire. But there still seem to be a good many people in Germany who have not yet been impressed with the changed conditions, and among them are quite a number of dealers in the rubber trade, who complain very loudly that the manufacturer does not turn out their orders as acceptably and as rapidly as he would in normal times. The rubber journals are taking these complainers to task, and seeking to convince them that under present trade conditions they should make all proper allowances for the extraordinary difficulties under which the manufacturer labours, and that they should not be too insistent on immediate deliveries or on getting exactly the quality at precisely the price mentioned in their orders.

The Allies' blockade is being felt more and more each day, and the list of rubber goods "no longer obtainable" is increasing constantly. Each day increases the inconveniences created by the lack of raw materials, and the discovery, or even the pretended discovery, of some new substitute for a scarce or "no longer obtainable" raw material is heralded throughout the press. It was announced lately that the Kaiser had motored to the front in a machine equipped with artificial rubber tires. Immediately the press announced that the great problem had been solved, that artificial rubber was at last practicable that Germany would no longer have to rely upon foreign countries for her crude rubber supplies. Rubber would now be home-made. It appears, however, now that the much-talked-of artificial rubber tires of the Kaiser's automobile were only experimental ones, produced at great cost, or at least at a cost that would prohibit their being produced on a commercial basis, or even on a basis permitting their use for the present military needs.

Another substitute that is receiving wide publicity in Germany appears to offer greater possibilities. It is known as "textilose," and is to be used as a substitute for the jute Germany formerly imported in great quantities from British India.

Textilose is made by spreading paper on a fibre gauze and cutting the product in strips, which are then spun into a yarn and can be woven in a similar manner as other paper yarns. Two factories are said to be producing about 44,000 pounds of textilose bags per day, and it is also stated that over 40,000,000 marks ($9,520,000) have been subscribed for the promotion of the manufacture of this jute substitute both in Germany and abroad.

When the war broke out there was a very large supply of cotton, and even after the beginning of hostilities, large quantities of raw cotton from time to time reached Germany. Manufacturers used freely of this supply, with the result that when the Allies tightened their effective blockade the supply of raw cotton was considerably depleted. Since August 1st the manufacture of

cotton goods has been absolutely prohibited. The government's order is far-reaching and strikes all kinds of goods made of cotton or containing any of this staple. Without distinction it prohibits the manufacture of all cotton yarns, cotton threads, fabrics, wearing apparel, bags, belts and all woven or knitted goods containing cotton. Since August 1st it has been legal to use cotton only in the manufacture of military requisites. Long before the government decided on these restrictions the price of raw cotton had reached the alarmingly high price of 30 cents per pound. The efforts made to encourage the planting and harvesting of hemp and flax have not yet given any material results.

Another government operation of great importance to the rubber industry is the recent seizure of all supplies of sulphur. However, the seizure of sulphur supplies is considered an advantage to the rubber trade, for the government has promised to distribute sufficient quantities to answer the immediate needs of all.

Lubricating oil is becoming so scarce and its price so high that only few rubber manufacturers can afford to use it for their machinery. Even graphite, which is used as a substitute therefor, is becoming rare and expensive.

The Allies' blockade has created such a rubber, gutta percha and copper famine that the D. V. E. (Union of German Electrical Engineers), which fixes the standards for rubber and gutta percha insulated wires, has been obliged to modify its standards to make their observance possible under present conditions. As far as possible iron will be used instead of copper, and rubber and gutta percha insulations will be replaced by impregnated paper wherever practicable. In cases where impregnated paper cannot be used, reclaimed rubber will take the place of the usual insulator until normal conditions are re-established.

The war has increased interest in farming here, and farmers, owing to lack of labour, are obliged to use modern machinery to a much greater extent than they formerly did. This creates an unusual domestic demand for many rubber mechanical articles, and especially for belts, in view of the fact that the use of leather for other than military purposes is strictly forbidden. But, because of the high cost of raw materials necessary for making these belts, it is almost impossible for manufacturers to make reasonable profits in producing these necessities. Of course, those who had a large stock of belts on hand are securing large profits, for farmers are glad to take what they can get and are using all sorts of belts on their threshing machines and other agricultural implements.

Packings and the like that can easily be made of substitute materials are giving but little trouble. The hose industry, generally speaking, is dead. No orders are forthcoming: people who use hose are doing the best they can by keeping their old hose in repair.

Before the war, maritime as well as river navigation offered a great market for all sorts of mechanical rubber goods. River navigation is at a standstill through lack of freight and lack of hands; maritime navigation, as far as Germany is concerned, is stopped almost entirely by the activities of the Allies' fleets.

In a word, the rubber industry here is badly affected by the war, and were it not for government orders for tires and other mechanical and surgical ubber goods, the whole industry would be at a dead standstill.

THE GERMAN SYSTEM.

As an illustration of the thoroughness with which the Germans conduct their military operations, a paragraph in a letter recently written from northern France is interesting. The writer says :—

"After every battle in which the Germans have been victorious the field is literally scoured, and all the junk is transported to headquarters. Scores of ripped and torn auto tires are collected and sent to an establishment where the rubber can be utilized in the making of new tubes."

GERMANY SAVING EVERY SCRAP OF RUBBER WASTE.

The saving of every possible scrap of waste rubber has now become such an important matter in Germany that not only the Imperial Government but State and Municipal authorities have taken the matter up ; and the Red Cross organization particularly is instructing the public in regard to collecting old rubber articles so that nothing shall be missed. The newspapers even go to the extent of giving general instructions as to how waste rubber articles shall be sorted before being turned over to the factories for use, so that the delay of re-classification may be avoided.

On June 1st, Austro-Hungarian rubber manufacturers increased their prices for rubber goods from 50 to 100 per cent.—INDIA RUBBER WORLD.

SMOKED SHEET AND SMOKE HOUSES.

B. J. EATON.

As enquiries are received from time to time from planters asking for advice on the phenomenon in connection with sheet rubber known on the rubber market as "stretching rusty or resinous," and frequently attributed by brokers to excess of resin in the particular rubber, it is thought advisable to make a brief statement with reference to this particular fault, which, although it probably has no effect on the real quality of the rubber, affects its market value and under present conditions of buying and selling must be taken account of and remedied.

The appearance which is usually produced when the dry rubber is stretched or lightly scratched, resembles powdered resin ; hence probably the broker's idea of the presence of excess of resin.

The phenomenon, however, is due to a sweating or exudation of the serum or mother-liquor left in the rubber, which comes to the surface as the sheet of rubber contracts on drying and, if unable to drain off or not removed by suitable methods, evaporates on the surface in the form of a thin film. This film is not obvious till the rubber is stretched or scratched, when it breaks up and on account of the reflection and refraction of light caused by small particles, its appearance is indicated by a deposit resembling powdered resin. All transparent substances, such as glass, large colourless crystals, light yellow resins, gums, etc., when in a thin film, would not be visible, but when powdered the minute particles all reflect and refract light and the powdered material becomes visible as a white or yellowish powder. The film of evaporated serum on sheet rubber behaves similarly.

Some time last year when investigating surface slime formation on slab rubber, i.e., fresh coagulum from the ordinary pans, which were only rolled or pressed lightly and which contained a large proportion of residual serum, a large amount of this deposit was naturally formed on the surface of these slabs; when the slabs were soaked in water, if the surface remained above the surface of the water in the tanks in which the slabs were soaked, this slime formed on the surface on standing, while on the side below the surface of the water it was dissolved off in the water.

An analysis of this slime, after drying completely in a desiccator, yielded nitrogen corresponding to a total protein content of over 60 per cent., the remainder being chiefly resin (acetone extract) and mineral salts. This proved that the film consisted largely of protein material as had been suspected.

REMEDY.

The remedy for this fault suggests itself, viz., to allow the sheets after machining and marking, to drain for an hour or two and then to soak them again in large pans of water, with one or two changes of water if necessary, subsequently scrubbing the surface of the sheets slightly with a stiff scrubbing brush, after removing from the water, and before placing in the smoke house. As a rule, the more concentrated the latex used in making the sheet, and the thicker the sheet, the more liable is this film to be formed.

This phenomenon is less likely to occur on ribbed sheets, i.e., with ribbed markings along the length of the sheets; since, on hanging to drain, the exudation from the rubber would drain more easily along the ribs.

A sample was received recently from an estate in which only one side of the sheet was affected. This was probably caused by the sheet having been placed on a table on which the serum from other sheets had drained.

CONTROL OF SMOKE ROOM TEMPERATURES.

The usual method of controlling the temperature in a smoke house is by means of a maximum and minimum thermometer.

The disadvantage of this instrument in recording temperatures is that a cooly can easily make up a fire early during the night so that the thermometer reaches a definite maximum and, for the remainder of the night, the fire need not be replenished, since the temperature will not drop very low till early morning. The actual maximum temperature may therefore have been maintained only a very short time and the drying may become slow.

The use of an instrument, however, which records the temperature automatically during the whole period obviates this difficulty and is an excellent check on the cooly. Such an instrument is known as a thermograph and is supplied by most scientific apparatus makers.

The instrument consists of an eight-day clock rotating a drum to which a paper chart is fixed. The chart is divided into days and hours, each chart covering a period of 8 days. Sufficient charts are provided with the instrument for one year and extra supplies can be purchased cheaply or a plain piece of paper can be used, as the temperature curve will show whether great variation of temperature has occurred. The instrument itself costs under £5; the clock, with chart attached, is enclosed in a copper case, which can be locked, so that the mechanism of the instrument cannot be interfered with. The only work involved is the winding of the clock once every eight days and the replacement of the old chart by a new chart.

DAMP SMOKE HOUSES.

One or two enquiries have been received in connection with the "sweating" of the rubber in smoke houses and the deposition of moisture on the rubber and on the interior of the building.

In these cases, it was found that outside smoking arrangements were employed, i.e. furnaces built up outside the smoke room, usually below the ground level, with a flue leading into the smoke room.

In one case, common moulds or mildews were actually found growing on the rubber in the smoke house.

As a rule such exterior smoking arrangements are unsatisfactory. The principle of smoking is slow combustion, producing a product rich in antiseptic constituents ; consequently to obtain a good smoke or vapour the fuel must burn slowly and at a comparatively low temperature. Many of the products of this slow combustion, although volatile, are easily condensed, and with an exterior furnace and long flue, these products condense in the flue or near the end entering the smoke room, and the water vapour which passes through, condenses in the smoke room itself, on the rubber and on the walls and roof of the room and causes "sweating" or deposition of moisture. Where the fuel is burnt in the smoke house itself, in boxes or holes in the ground, there is sufficient heat to drive the water vapour out and only the other products are left to diffuse into the rubber.

One factor in connection with smoking which is frequently not realised, is that the drying caused by the heat is far more effective than the actual smoke products—creosote, etc.—as a preventive of moulds.

This is well known in connection with the smoking of bacon and meat in general.

It has been actually stated by scientific workers that, where moulds appear on smoked sheet, the rubber could not have been properly smoked. This is entirely erroneous. The common mildews will grow most readily on the best smoked sheet, given the proper conditions subsequently, i.e. suitable moisture conditions.

One of the simplest methods of inducing mould growth on smoked sheet is to wrap the sheet in paper—especially newspaper.

Several cases have occurred also in which No. 1 pale crepe and smoked sheets have been despatched by an estate manager in perfect condition, and owing to becoming damp in the hold of a ship or by subsequent accidental contact with sea water, moulds of various kinds have developed and discoloured the rubber and the manager has been blamed wrongly. This has been proved by actual instances, in which cases of rubber despatched for the last International Rubber Exhibition, which had previously been inspected by the Director of Agriculture and the writer and found to be in perfect condition, were accidentally dropped into the sea at Port Swettenham and when returned to the Agricultural Department were found to be discoloured by most of the usual fungi which have been found by the mycologist to produce such effects.—F. M. S. AGRIC. BULL. VOL. III., No. II.

COCOA.

CACAO FERMENTATION.

MR. HARVEY BRILL of the Bureau of Science, Manila, communicates an interesting article on the Enzymes of Cacao to the March number of the PHILIPPINE JOURNAL OF SCIENCE, in which he seeks to trace the causes of the changes which take place in cacao fermentation. From this article we quote as follows :—

The necessity for fermenting or sweating cacao is now generally acknowledged. The principal changes brought about by this process are :—(1) The removal of the greater portion of the sugary pulp or parenchymatous tissue surrounding the beans, (2) the dissociation of the bean from its testa or seed coat, (3) the promotion of chemical changes within the seeds, (4) the conversion of the bitter astringent taste into a palatable sweet one, and (5) an improvement in colour, break, and flavour. Investigators are not agreed as to the cause of these changes and attribute them to the action of various agencies. HART contends that the process of fermentation or sweating in cacao consists in an alcoholic fermentation of the sugars in the pulp of the fruit accompanied by a loss of some of the albuminoid and indeterminate nitrogenous constituents of the beans . . . . . Some parts of the carbohydrates other than sugars undergo hydrolysis and either escape in the runnings from the boxes in the form of glucose, or undergo in turn the alcoholic and acetic fermentations. During this change some of the astringent matters to which the somewhat acrid taste of the raw beans is due are also hydrolised, and thus a marked improvement in flavour is gained.

HARRISON holds the same view. A. SCHULTE IM HOFE, in an investigation carried out at Victoria, in Cameroon, came to the conclusion that the changes brought about in the cacao bean during fermentation were the results of an oxidation process and were precisely similar to those taking place during the conversion of green tea into black tea. He made no attempt to determine if the oxidation was due to the action of enzymes or arose from other causes. That the fermentation is the result of biological action is the conclusion of J. SACK.

PREYER has isolated a yeast, *Saccharomyces theobromæ*, from fermenting cacao and has recommended the use of the pure culture of this for the initiation of the fermentation. Besides the above he observed *S. cerevisiæ*, *S. ellipsoidies*, and *S. membranæ-faciens* in fermenting cacao. Others have noted the presence of *Penicillium* and *S. apiculatus*. However, not much success has been attained with the use of pure cultures of yeasts, and not much development can be looked for along this line, since the use of a pure strain of yeast would necessitate the sterilization of the culture medium, the cacao. Sterilization would destroy the enzymes present. BEHRENS has pointed out that the changes desired from fermentation do not occur when the enzymes are destroyed. That the colour change in the bean from white or violet to brown is only indirectly produced by fermentation, is maintained

by LOEW. He insists that the brown colouration is due to the action of the oxidases or oxidizing enzymes, since this same brown colouration is produced when the beans are crushed and exposed to the air. These oxidases are stored up in the protoplasm of the bean of the cell and are liberated when the cells are killed, without injury to the enzyme. The enzyme then becomes active. It is a very generally accepted belief that enzymes are an important factor in the changes tobacco undergoes during the curing process. With this in mind, OOSTHUIZEN and SHEDD have investigated the enzymes of the tobacco plant. Many plants and plant products are being investigated to discover the enzymes present and thus throw some light on the changes they undergo when ripening and germinating and their influence on the system when used for foods. On account of the great interest manifested in enzymology and in the hope that some light may be thrown on the case of the changes taking place in the fermentation of cacao and on the real nature of the changes themselves, this investigation has been undertaken.

The writer then furnishes details of his experiments involving tests for lipase, emulsin, casease, albuminase, protease, inulase, reductase, oxidases, diastase, invertase, raffinase and maltase, and concludes as follows:—The pulp surrounding the cacao bean contains a greater number of enzymes than the fresh bean itself. The pulp shows activity for the enzymes, casease, protease, oxidase, raffinase, and invertase. The fresh bean gave reactions for casease and raffiinase, and very strong reactions for oxidase. The fermented bean reacted for casease, protease, oxidase, diastase, raffinase, and invertase. The fermented bean shows the presence of protease and invertase, both of which are absent in the fresh bean, but present in the pulp. These must have penetrated the membrane surrounding the bean during fermentation. Diastase is present, but absent in the extracts from the fresh bean and from the surrounding pulp. This has been developed in the bean itself during the process of fermentation. Therefore, the conclusion is reached that the presence of these enzymes undoubtedly influences the character of the fermentation and that temperature control during fermentation is necessary in order that they may not be destroyed,

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THYMOL FROM AJOWAN SEED.

The bulk of India's export of Ajowan seed (*Carum copticum*) went to Germany before the war. In 1912-13 the export was 21,650 cwt., of which 19,055 was appropriated by Germany. In 1913-14 the export only reached 9,784 cwt. of which 6,990 went to Germany, from which it will appear that though the exports to the enemy country have decreased considerably the trade has not been taken up in the United Kingdom or elsewhere. The CHEMIST AND DRUGGIST, in drawing attention to this fact, points out that the share of the United Kingdom in 1914-15 was 382 cwt. against *nil* in the preceding two years. The output of thymol from Ajowan seed is about $1\frac{1}{4}$ per cent. In August last the drug was about 10*s*., rising to 45*s*. in September and declining to 24*s*. in April. At present the scarcity is said to be acute, the English article (obtained from thyme) being unable to meet the demand at 27*s*.

COFFEE.

ARABIAN COFFEE IN UGANDA.

The present year has been a decided improvement as far as the Leaf disease and Die-Back are concerned. No doubt the climatic conditions of the present year have been as favourable to the coffee trees as the climatic conditions of the previous year were unfavourable, for the advent of the leaf disease culminated in a spell of drought seriously crippling the trees ; whereas the greater rainfall during the present year, although giving the disease a fresh impetus—for the disease has been present to a considerable extent—also created vigorous growth in the trees which were thus enabled to keep pace with it. How far and important is the part played by the weather conditions in the life of the disease may be seen at a glance from the chart overleaf.*

It will be noticed that a high rainfall preceded the gradual rise of disease causing defoliation; then extreme drought causing wholesale die-back and numerous deaths amongst the trees. This spell of drought was phenomenal and resulted in a serious shortage of food among the natives, and in parts a serious lack of water. This drought subsided in September of that year by a rainfall in one day of 1·68 inches. This stimulated the trees into new growth, with a sufficient subsequent rainfall to maintain it. This new growth enjoyed meantime partial immunity from the disease, but then again a gradual rise in the percentage of disease present takes place with the increasing rainfall. The rapid falls in the disease are due to the trees having supplemented their leaves by a new leaf system. This in two cases, i.e., from September 1913, and November, 1914, was enhanced by drought followed by a good rainfall, and in the other case, viz., September, 1914, by a natural process of the renewal of the leaf system.

Comparing then the climatic conditions of last year and the leaf disease and die-back with the climatic conditions of the present year and the improved condition of affairs as regards leaf disease and die-back, it would appear that what we have most to fear are the spells of drought which deprive the trees of the stimulus necessary to enable them to resist the disease, for, as was pointed out in a previous report, the high percentage of die-back among the trees was due in large measure to the phenomenally dry conditions then prevailing. This contention was again borne out by the considerable die-back present during the short drought of December and January, 1914-15.

That the effects of the leaf disease and die-back have considerably

* Not reproduced.

reduced the yields of the trees will be seen from the following records:—

COFFEA ARABICA.

Nyasaland Variety 5½ years 9 by 10 in.

No. of Plot.	Total No. of Trees.	No. of Good Trees.	No. of indifferent Trees.	No. of Deaths.	Total Yield of Berries.	Average Yield of Berries.	REMARKS.
1A.	249	87	115	47	49 lb.	3·88 ozs.	Unmanured.

These 249 trees make up 4 rows of the original coffee on the Plantation. This plot was so much affected by the leaf disease and die-back that during the latter part of 1913 it was uprooted, with the exception of these 4 rows which were left as a test. Assuming that a tree 5 years old should produce at least 1 lb. of parchment coffee, it will be seen that the bearing capacity of these trees has been reduced by three-fourths, if not considerably more.

Nor are the facts any more encouraging in the next series of plots, with perhaps the possible exception of No. 1, which were also considerably affected by leaf disease and die-back. These plots show a high percentage of indifferent trees. It is interesting, however, to notice that the only plot which is anyway near the normal is the manured one with a greater number of normal trees and consequently a higher average yield. These plots were on a par, previous to the manurial test.

Nyasaland Variety 4½ years 6 by 8 in.

No. of Plot.	Total No. of Trees.	No. of Good Trees.	No. of indifferent Trees.	No. of Deaths.	Total Yield of Berries.	Average Yield of Berries.	REMARKS.
					lb.	ozs.	
1	767	590	126	51	287½	5·3	Manured with Farmyard manure and Kainit and pruned in 1913.
2	1328	653	533	42	108	1·45	Unmanured.
3	1439	589	786	64	138½	1·61	Unmanured.

The only coffee which is in a normal state of health at present is the series of the younger plots. These plots, although they were diseased, were never seriously affected by it, as during the advent of the disease they had not yet reached a reproductive stage and were therefore not handicapped by crops. The die-back is present only in the older plots where there was an excess of leaf disease and excessive cropping. The yields from the younger

plots are as follows:—

Nyasaland Variety 3 years 8 by 3 in.

No. of Plot.	Total No. of Trees.	No. of Good Trees.	No. of indifferent Trees.	No. of Deaths	Total Yield of Berries.	Average Yield of Berries.	REMARKS.
4	737	737	Nil	Nil	lb. 251½	ozs. 5·44	Manured with Cotton seed.
5	312	312	Nil	Nil	100	5	Unmanured.
6	1588	1588	Nil	Nil	611½	6·16	Part of this plot was manured with Basic Slag. 1913.

—ANN. REPT. OF THE DEPT. OF AGRIC., UGANDA PROTECTORATE, 1915.

DIE-BACK IN UGANDA.

Almost a hundred examples of this Coffee trouble have been examined in the laboratory during the year. In many estates this die-back has caused a serious loss of trees, and in others a serious loss of bearing wood, and, therefore, of crop. On the older estates, it was most common when *Hemileia* disease was at its worst and afterwards, and there is always a certain amount of it on all plantations.

The tips of affected branches blacken, and the leaves fall; the berries very often remain on the branches, but they become brown and do not mature. At first, only a few branches are affected. These may occur at different levels in the centre of the tree. A further stage shows the gradual drying-up and death of practically all the primary branches, situated above the oldest primaries at the base of the stem and below the young green apical shoots. Thus is produced a tree with a lower mass of well-developed leafy primary branches, an upper crown of fresh green shoots, and an intermediate area which is naked, barren, and unsightly, and consists of projecting primaries which have lost all interest in life.

This condition is the result of physiological causes, and is not due to fungoid attack. It was thought at one time that "die-back" trees were affected by a bark disease, caused by a fungus of the nature of the *Corticium* which attacks *Hevea* and other crops, but this idea has been entirely departed from. The following two paragraphs may perhaps give an explanation of Uganda Coffee "die-back."

During the first years of the coffee-tree's growth, the basal primary branches, which are the oldest, are enabled to make good secondary growth and thoroughly to establish themselves. Therefore, when flowering and bearing commence, they are able by their own efforts, and with the help of their secondary branches, to ripen their crop and survive the ordeal. The young apical primaries bear no crop, and they, having no extra strain put upon them and having to hand their full share of sap, continue to grow and increase. The intermediate mass of primary branches—the ones which die back—find themselves unable, of their own unaided efforts, to ripen the large maiden crop

they invariably bear. They are not yet well-established, and they collapse under the strain put upon them. Inspection of a coffee tree in this condition shows that some of these primaries succeed in ripening their whole crop and then die, while others, after ripening only a part of the berries, give up the effort to do any more. The dead branches are lost for ever to the tree. Others which survive may linger on for some time, with, as a rule, only one apical pair of leaves. In this way, a gap in the symmetry of the tree is made, and, should the same effects follow the incidence of the next flowering season, an exceedingly useless and unsightly tree is produced.

The Coffee "die-back" is thus to be regarded as the direct effect of a form of over-bearing, and, on this assumption, the following measures are recommended.

Where "die-back" is common, and it is desired to adopt remedial measures, these should take the form of stumping affected trees. The cut should be made through the stem at the top of the basal portion which bears the healthy primary branches. A new sucker can be raised from this stump, and the tree restored in time to its normal shape.

Preventive measures are strongly recommended to those who are able to adopt them. They consist in the prevention of over-bearing by the branches under discussion by relieving them of their maiden crop. The young berries should be pulled and rubbed off the trees. This operation is best performed within a month after flowering. If it is carried out too soon after the flowering, a set of new buds will be produced, and if it is delayed until the berries are well-grown, and the bearing branch shows signs of sickness, the benefit of the operation is lost. The harm is already done, and the branch is in the grip, so to speak, of the "die-back."

The carrying out of this operation on a fair-sized estate will undoubtedly prove costly, but it will most likely require to be undertaken only once, and that during the second or third year of the plant's life, and only on those branches that attempt to bear on green wood. Expense and loss of crop (the latter being negligible because the lost berries would not, in any case, come to maturity) will be repaid by the development of naturally and symmetrically branched trees, and the subsequent evenness of crop borne. Secondary and other branches can be replaced, but lost primaries *never can be.*

In this connection, it is to be regretted that the operations of removing from young trees all tender superfluous growths, of systematic pruning of older trees, and of keeping clear around the main stem a cylindrical vertical passage a foot in diameter by removing secondary branches, are not more frequently carried out. Good cultivation is also necessary.

The fungi found on "die-back" trees are *Periconia Byssoides.* Pers., *Fusarium coffeicola*, P. Henn., *Phoma sp.* (probably new), *Fusarium sp.*, *Tubercularia sp.* and a *Colletotrichum.* The first-mentioned form and the two species of *Fusarium* were also found on young trees killed by lightning. The *Phoma* and the *Tubercularia* were found only once. None of these species is constant in its presence on "die-back" branches, and other imperfect forms found only very occasionally are not suggestive of parasitism. These fungi are undoubtedly only saprophytic.

The foregoing remarks do not bring into the question of the prevalence of die-back a factor which has undoubtedly had a great influence upon it, the

baneful effects of *Hemileia* disease—the loss of leaf-surface and the consequent reduction of the working efficiency of the weakened tree. Branches which never bore or attempted to bear any crop have died back solely because of their loss of leaves and the general low condition of the parent tree caused by the demands made upon it by the necessity for renewal of a lost or damaged leaf-system. Die-back, again, is favoured when weeds have been allowed to interfere with the nutrition of the trees, where the soil is poor, and where a period of drought has been experienced, the last being the case in certain districts immediately after the epidemic of *Hemileia* which lasted over 1913. Like *Hemileia* itself, it is not at present so much in evidence as it was during 1913 and the earlier part of 1914. In other words, many trees have "recovered," but the planter is still faced with the fact that owing to the loss of primary branches, he cannot take from his trees the full crop they ought to yield.—ANN. REPT. DEPT. OF AGRIC., UGANDA PROTECTORATE, 1915.

COFFEE AND COFFEE PLANTING.

That there is a growing demand for coffee is shown by the statistics of the United Kingdom's foreign and Colonial trade. In 1910 this country imported 936,778 cwt. of raw coffee, valued at £2,303,014. In 1914 the quantities had increased to 1,036,705 cwt., valued at £3,546,231. This raw coffee is the basis of one of our greatest transhipment trades, and we find that of the total imports the greater part is re-exported. For instance, in 1914 we re-exported 669,803 cwt. of raw coffee, valued at £2,194,945; but this transhipment business, although there was a spurt in the last half of 1914, owing to the war, has been tending to decline, for we find that such transhipments were 753,338 cwt. in 1910, and only 439,236 cwt. in 1912, a falling-off explained by the more direct trade springing up between coffee-growing countries and Continental ports. The great increase in this trade which took place in 1914 must, therefore, be attributed entirely to the closing of Continental ports since August of that year.

SOURCES OF SUPPLY.

It will be interesting to touch briefly upon the principal sources of supplies reaching this country. These in 1914 are shown in the following table:—

	Quantities.	Values.
Brazil	333,488 cwt.	£954,247
Costa Rica... ...	236,842 ,, ...	£905,404
Colombia	83,022 ,, ...	£296,294
Guatemala... ...	76,825 ,, ...	£268,889
Mexico	34,859 ,, ...	£123,818
Java	30,429 ,, ...	£97,663
Salvador	27,277 ,, ...	£92,483

It will be noticed that all of these are foreign markets, and an examination of the statistics since 1910 shows that we are obtaining larger supplies from Java, Mexico, Salvador, Costa Rica, Colombia and Brazil. The total imports from foreign countries in 1910 were 797,087 cwt., valued at £1,866,589. These imports had increased in 1914 to 880,837 cwt., valued at £2,938,511.

Our imports of raw coffee from British possessions have also increased, viz., from 139,691 cwt. in 1910, valued at £436,425, to 155,868 cwt., valued at £607,720 in 1914. Among British coffee-producing countries by far the most important is British India, which supplied last year 124,332 cwt., almost double as much as in 1913, and here again the effects of the war can be traced. A steadily improving market is British East Africa, from which the quantities increased from 866 cwt. in 1910 to 16,124 cwt. in 1914. There is also a satisfactory improvement in the British Guiana trade, but our imports of raw coffee are either at a standstill or declining as regards Nyasaland, Aden and Dependencies, the Federated Malay States, Ceylon, and the British West India Islands.

CAPITAL AND PROFITS.

An excellent book* on coffee-planting and the preparation of coffee for the market has recently been published at Aberdeen. The author, who has adopted the *nom de plume* of "Jotapeu," is MR. J. P. UGARTE, the Consul in Aberdeen for the Republic of Salvador, and his long experience of the coffee trade, and especially his acquaintance with the best methods of preparing the coffee bean, entitle him to speak with authority on the practical points involved. MR. JOTAPEU has arranged his book in seventeen chapters. Of these the first two deal mainly with the profit to be derived from coffee-planting, and in this connection the author furnishes some interesting particulars of the cost and returns of a plantation in Mexico. He finds that the annual nett profit on capital invested is 90 per cent. To start a plantation of 500,000 plants, 50,000 dollars capital is estimated to be sufficient, say 10 cents for each plant. At the end of the third year the first crop would be obtained —a minimum of ½ lb. from each plant, or say, 250,000 lb. of coffee, which at the low price of 10 cents per lb. gives 25,000 dollars or 50 per cent. on the capital invested. At the end of the fourth year each plant produces 1 lb. of clean coffee, which at the same price would give 50,000 dollars. Allowing gathering and general expenses to absorb the 25,000 dollars produced by the first crop, the planter at the end of the fourth year has not only reimbursed the capital outlay of 50,000 dollars, but is also possessor of a plantation which will continue to give large yearly profits. This applies in the respective proportions to a plantation of 10,000 or 100,000 plants. The United States Consul-General in the city of Mexico, in a report to his Government, has estimated that the profits obtained from coffee-planting vary, but that the lowest shows something like 100 per cent. per annum on the capital employed. As regards the yield, that of one plant is given at 1 lb. of coffee, but 2 lb. per tree after the fifth year would be the average, judging from the yield of well-established and properly managed plantations. Naturally the cost of a plantation varies somewhat, according to the locality, but the author points out that unquestionably coffee-planting is a profitable investment, even when conducted on a limited scale in connection with general farm operations.

THE MANAGEMENT OF PLANTATIONS.

There are a number of hints in this section of the book, evidently based on experience, as regards the varieties of coffee best suited to different

* THE CULTIVATION AND PREPARATION OF COFFEE FOR THE MARKET. (With twenty-five illustrations). By JOSE JOTAPEU. 1915.

localities, and there are also interesting notes as to the management of coffee plantations. One of the most important things to have, the author says, in a coffee plantation is a medical book dealing with and describing methods for attending emergency cases and minor sufferings, such as snake bites, cases of malaria, dysentery, etc. A medicine chest is also necessary. In all the coffee estates he visited in Mexico and Central America this is done, particularly in plantations situated at long distances from any professional assistance. Then there is the question of central stores, and it appears that on some estates which the author visited in Mexico and Central America the natives employed can procure their main necessaries of life, such as maize, rice, corn, beans, salt, clothing and light agricultural implements from stores run by the planters. On some estates he noticed that on pay-day the majority of the natives used to spend the greater part of their earnings, if not all, at such stores. The book also touches upon the treatment of the plantation labourers, and shows how this can be made conducive to efficiency and economy.

VARIETIES OF COFFEE AND CULTIVATION.

One of the most interesting chapters is that entitled "Species of Coffee." This deals with the characteristics of the principal varieties and the climates suitable for them, such as the Arabian coffee, the café Amarillo, or yellow coffee, the café Hibrido de Liberia, red coffee, a variety of Arabian, the Robusta and the Liberian. With reference to the last-named, he mentions that this is not by any means in such great demand as the other species, for although its cultivation is easier its preparation for the market differs somewhat, necessitating machines specially adapted, and the loss in weight in preparing it for the market is very great. Of 50 lb. of ripe cherry coffee (Liberian), only 4½ lb. of dried, shelled beans are obtained, an equivalent of 91 per cent. loss in weight, the average loss being 85 per cent.

Another important question or series of questions is touched upon in the chapter headed, "The Planter's Enemies." In this the diseases of the coffee tree are discussed, and the author's experience should be of great interest to the planter. The value of spraying is emphasised, and particulars of the insecticides to be employed are reproduced. Among the troubles which can be checked and often entirely eradicated are the "Ojo de Gallo," or Cock's eye, the "Pulgón" or bug, the "Hemileia Vastatrix" the most dangerous of all coffee diseases, and the "Taladrador" or borer. There is a brief but practical chapter on the use of fertilisers, the results of experiments with these being tabulated.

In the section dealing with cultivation the questions of shade trees, and of bushes and trees to serve as a protection against wind, and the quick evaporation of moisture from the soil are discussed, and there is a note on the adulteration of coffee. Planting and pruning complete the first part of the book, and the pages on these subjects touch upon the selection of ground, the most favourable altitude, and distance between the trees. In Central America, Arabian coffee begins to yield in the third year, giving a minimum crop of three-quarters of a pound per plant. At the end of the fourth year the yield gives an average of 1 lb. per plant. In the fifth year the trees in full bearing sometimes yield from 2 lb. to 4 lb. One or 2 lb. from each plant is a very safe yield to calculate upon.

THE CURING OF COFFEE

THE LATEST PROCESSES AND MACHINES.

No point is more insisted upon by MR. JOTAPEU than that a coffee plantation is most successful when the management is under the personal supervision of the owners. This supervision, however, must not end with the planting. A planter or "hacendado" must also supervise the working of the "beneficio," or curing plant; and the second half of his book is devoted to this subject. The coffee planter, he adds, is liable to lose a considerable amount of money on one crop alone, and we do not think it is an exaggeration to state that a careful study of MR. JOTAPEU'S pages and the carrying out of the advice given will go far towards helping planters to avoid such losses. Modern machinery has brought many changes in the preparation of coffee for the market, such as pulping, fermenting, washing, drying, hulling, polishing and grading, and the processes involved, together with the latest forms of machinery now employed, are described in an intelligible manner and with the aid of numerous illustrations. Having described how the coffee is best received from the native labourers and the respective quantities checked and recorded, MR. JOTAPEU describes the pulping process and the newest machines for carrying it out. As to the advisability of fermenting coffee he also expresses an opinion, based on practical experience, and he then enters fully into the question of drying, pointing out that open-air drying grounds are being gradually abandoned in favour of drying machines, and he shows why this must necessarily result from the improvements now embodied in appliances of this kind, which can be heated economically, either by exhaust steam heaters or by direct fire-heating. An important stage in the preparation of coffee, namely, husking, has a chapter to itself, which is followed by another on the new method of polishing coffee by means of phospher bronze polishers, and the machinery for these processes in their latest developments is dealt with. The hulling of dry cherry coffee, also the subject of treatment by new machines, is next described, and this brings us to the concluding operation, viz., grading or classifying, in which a series of machines is noted. MR. JOTAPEU points out that coffee used simply to be classified by its thickness, making three grades, viz., firsts, seconds and thirds. The percentage of firsts seldom exceeded 25 to 30 per cent. This is the old and wrong way of classifying coffee, because the beans, though they may be of the same thickness, may yet differ a good deal in their width and length. The sample of firsts by the old method of grading was very irregular. The European coffee markets demand nowadays that coffees should be very uniform in appearance, and in order to comply with this demand, coffee must be graded first of all by its thickness, being the smallest dimension, then by the width and afterwards by the length, these two latter dimensions being more apparent to the sight. Up to the present no single machine is able to make the above three classifications, but two machines can be combined to produce the results demanded. Descriptions and particulars of these machines very appropriately conclude one of the most useful and most practically written books on the subject of coffee which planter or trader can have.—THE BRITISH TRADE JOURNAL.

TOBACCO.

CIGARETTE TOBACCO IN INDIA.

Trials made in Northern India (where of course the conditions are entirely different from those obtaining in Ceylon) have gone to prove that local strains of tobacco are more likely to prove suitable for cigarette making than types introduced from America. THE INDIAN TRADE JOURNAL contains the following reference to these trials :—At the request of the Peninsular Tobacco Company, a good deal of work has been done at Pusa in the search for a suitable cigarette tobacco for Bihar. Seed from all the chief tobacco localities in India was collected and the types found in this seed have been separated in pure culture and classified. All the likely types of this collection were grown at Pusa and cured both on racks in the sun and also on the ground. Large samples of the cured product were sent to the factory and actually made into cigarettes. At the same time, a number of American varieties* suitable for cigarettes, were also grown and tested in a similar way.

In a BULLETIN (No. 50 of 1915) recently issued by the Agricultural Research Institute, Pusa, MR. and MRS. HOWARD explain that the results of those numerous trials were somewhat unexpected. All the American varieties proved unsuitable as they did not grow fast enough in Bihar to have the least chance of success with the cultivators. In all cases, the seedlings were weak and lagged behind the robuster Indian forms. The Americans were about a week to ten days late in transplanting and this slowness of growth was also seen in the ripening process. All the introduced kinds were too late for Bihar. As regards the colour, texture and flavour of the American sorts, the results were disappointing and in no case was a variety found combining the requisite colour, texture and flavour for cigarette manufacture.

The Indian varieties are reported to have given much more promising results. Many of the Bihar kinds gave good colour and flavour when cured on racks, but all were deficient in texture. Only one, out of all the fifty-one Indian types grown at Pusa, showed itself to possess the desired combination of texture and flavour with a fair colour when cured on racks or on the ground. This was Type 28, a kind found in a sample of seed from South Bihar. This variety has given good results for several years both on racks and also when cured on the ground. On the large scale, under estate conditions, it has done exceedingly well and a great demand for seed has arisen not only in Bihar but also in other parts of India. Type 28 has also been taken up by the people for the local trade as they find that, topped low in the country fashion, it gives a heavy yield of produce.

* The American varieties tried were—Burley, Long leaf Gooch, White stem Oronoko, Easter Pride, Conqueror and Granville.

STEWART CUBAN.

H. K. HAYES.

The type of tobacco known as Connecticut Cuban Shade was first introduced into America in 1904 from Cuba. A selected strain of this variety has been grown continuously since then and has shown considerable evidence as to its homogeneity. Selection for high leaf-number during four years did not raise the mean from its original number 19·9. During the harvest of 1912 certain plants were observed with a large number of unpicked leaves and no inflorescence. These were removed to a glasshouse where they blossomed in January and bore 72 leaves on the stem. Seed from these new types sown in 1913 produced plants of uniform appearance but differing from the normal Cuban in having leaves of a somewhat lighter green shade, in a partial absence of green suckers, and in a practically indeterminate growth. Whereas the normal Cuban type bears a terminal inflorescence after producing from 14 to 25 leaves, this new type blossomed in November, after producing from 60 to 82 leaves per plant. In 1913 this new type, known as "Stewart Cuban," was grown as a field crop and manufactured by the Windsor Tobacco Corporation. The quality of the leaf was equal to the normal type and its yield 90 per cent. higher. Owing to its prolonged period of growth seed cannot be obtained without transplanting to a greenhouse in the late autumn.

Other mutations giving a higher leaf-number and an abnormal growing season have been observed in the case of Connecticut Havana, which has shown a uniform type for over 50 years. The same mutation has appeared in different parts of the country, but has only appeared for a single generation.—BULL. OF THE INT. INST. OF AGRIC.

CIGARETTE PAPER.

According to the PAPER MAKER AND BRITISH PAPER TRADE JOURNAL a good cigarette paper must be absolutely neutral in flavour and aroma while the cigarette is burning. Flax or linen, hemp and ramie fibres are all that should enter into a cigarette paper and even the selection of these is of importance. All other paper materials are banned by defects such as "biting" of the tongue, irritating of the throat, objectionable odour, etc. Cotton, wood and straw enter into the inferior qualities, bamboo fibre and maize husk being also sometimes employed. "Rice paper," one time the boast of the high grade cigarette, is a thing of the past. The process of manufacture itself is a most complicated one, including among other things "cooking" with the aid of chemicals. The profits of the trade in cigarette paper have greatly fallen off of late owing to the manufacture of low grade goods which have taken the place of the better article. The competition too is severe, Austria and Italy contending for the trade in the East; and Austria, Germany, and France being rivals in the continental markets. The war has forced America into the trade, but prejudice is in favour of the foreign article though American cigarette paper is quite up to standard.

FRUIT.

PRUNING.

PROF. F. C. SEARS.

Why is it that almost any one who takes any interest at all in fruit growing likes to prune? Ask most fruit growers, particularly those who have time to get the real enjoyment of the work, what they would rather do about the orchard, and ten to one will say "prune." One does not need to look far for the reason either. Few, if any, of the other operations call for so much knowledge and such good judgment, and none of them puts you in such intimate touch with your trees. The man or woman who cannot become enthusiastic over the pruning of a tree, especially a young tree, is certainly difficult to enthuse.

SHALL WE PRUNE?

As a practical orchard matter the question of whether we shall prune or not is, of course, almost always answered in the affirmative, but there are a few men who prune little, if any, particularly on young trees, and the amount of pruning done varies tremendously, some men being very severe and others doing none at all, or at least very little. With the young trees there is a "school" of orchardists of fairly respectable numbers who do not believe in pruning at all, at the time of setting. They argue that the tree needs all its vitality to recover from the operation of transplanting and that to remove any of the top reduces by just so much the total vitality of the tree.

On the other hand, most growers prune the tree severely when it is set in order to reduce the top to correspond to the reduction of the root system which has been necessitated by digging the tree. This argument has always appealed to me as a sound one, and what experimentally I have done along this line has served to confirm my belief in the practice. I believe, however, that after the tree is established but while it is still young, say from the second to eighth year, it ought to receive very little pruning. In practice I have tended, during recent years, steadily towards less and less severe pruning of such trees. At the present time all that I would do to such a tree is to take out crossing branches, to look carefully after the development of the main branches and possibly to do a little additional thinning. I think we are likely to overlook the fact that trees of this age, being relatively small in bulk, can afford to remain more thick than trees of larger volume, and it seems to me that so long as we can keep such trees open enough to give us well-coloured fruit, the less pruning they receive the better. The most important reason for curtailing our pruning at this stage is the reasonably well-established fact that unpruned trees, or those which at most receive very little pruning while young, come into bearing relatively early.

The past month I had the pleasure of visiting a young orchard in the Annapolis Valley, Nova Scotia, which had been set for nine years. It was made up of Northern Spies and Wageners and the Spies had never been pruned at all. Now the Spy is proverbially slow in coming into bearing, and

yet some of these young trees bore half a barrel of apples at seven years, and at nine years the majority of them were in bearing and many trees gave from one bushel to one-half barrel of fruit. Other instances might be cited showing the same results.

REASONS FOR PRUNING.

If we are to prune we ought to acquire as clear a conception as possible of why we do it, and most of the intelligent pruning of fruit trees is done for one of the following three reasons:—

(1) To control size and shape of the tree. This is the only type of pruning that the writer would do while the trees are young and it varies with our ideals, all the way from the man who merely sees that the main branches are satisfactorily distributed on the trunk, and that there are no crossing branches of any size, up to the man who insists that the tree take some specific shape, as horizontal cordon or espalier. As already suggested to me, it is the most interesting of all phases of pruning, for one works out his ideas and co-operates with the little tree to produce very definite and specific results.

(2) The second general reason for pruning is to influence the bearing habit of the tree, to make it bear more or less fruit. Usually it is the former which we aim at, but occasionally we do pruning with the definite purpose of making the trees bear less fruit. This is especially likely to happen with such varieties as Wealthy and Wagener which bear very freely and on which the apples are likely to run small as the trees get older. It is often advisable to give such trees a severe pruning with the idea of starting them into renewed wood growth, which will reduce the amount of fruit and increase the size of the individual apples.

(3) The last general reason for pruning is to influence the character of the fruit, to make it better in colour and finer in quality. This comes into play as the trees get older and is the reason which we most commonly have in mind as we prune.

GENERAL PRINCIPLES.

Let us glance next at some of the general principles which govern the pruning of fruit trees. We can do little more than mention them here and yet they must be understood if one is to prune intelligently.

(1) The first of these is that the season of the year in which the pruning is done is likely to influence the result. Where one prunes in summer the tendency is toward fruit bearing, and where one prunes during the dormant season the tendency is in the other direction. If summer pruning is to be most effectual it must not be severe, and must consist in a mere checking of the growing tips. The explanation of this result is simply this: Our tree is to be looked upon as a manufacturing plant with a certain capacity in manufactured plant food per day. The growing tips draw most heavily on this output for materials to make new leaves and twigs. Now, if we stop this new formation of parts, we have still the same amount of manufactured food and therefore a larger amount for the use of the developing buds, and as a con sequence these buds can develop into fruit buds instead of having only materials enough for the less-highly developed leaf buds.

In distinction to this we have the effect of pruning in the dormant season. When the tree goes into winter quarters there is a practical equilibrium between the roots and top. If we take off half the tops we have 100

per cent. of root surface to supply 50 per cent. of top, and the result is that the 50 per cent. makes a rank wood growth and gives little fruit.

(2) The second general principle is that checking the growth of the tree tends to make it bear fruit. This checking may be brought about in various ways. One important way is by summer pruning as just discussed. Another is by the increasing age of the trees. As they get older they grow more slowly and consequently bear more generously. The application of fertilizers has a very important effect on production, some kinds tending towards wood growth and away from fruit and others tending in the opposite direction. Diseases almost always tend toward fruitfulness. As the tree becomes decrepit it tends to reproduce itself and is thrown into fruit-bearing.

(3) The third, and perhaps the most important, of these general principles is that the pruning should vary with the kind or class of fruit tree. This is because different fruits bear in such different ways. Apples, for example, bear on short stubby spurs which may live and produce fruit for ten or fifteen years and in that time not make a growth of over six or eight inches. These spurs must, therefore, be preserved at all costs, and the pruning is relatively slight. In contrast to this peaches bear altogether on the new wood of the previous season's growth, and the pruning must be relatively severe in order to keep up a supply of this new wood. The other fruits vary between these extremes, and each requires a little different treatment in order that we may secure the best results.

(4) A fourth general principle is that the pruning must vary with the age of the tree. This has already been touched upon. The young tree may be left with a thicker top, and in many cases must be so left if it is to develop into the best type of tree. Take young pears, for example, or some of the upright growing varieties of apples and plums. If these are pruned so as to give the proper amount of density to the top while young, they will, as they get older and bear fruit, spread out so as to make too open a top.

(5) We have lastly the general principle, closely allied to our first principle, that severe pruning of the top at any season always tends to strong wood growth, while little pruning or no pruning at all tends towards fruit.

When we come to the actual operation of pruning, there are many interesting details. When shall we prune? How shall we prune? What shall we prune with? Shall we treat the wounds, and if so, with what?

PRUNING TOOLS.

Naturally the first step for real work is to provide oneself with a convenient and efficient set of pruning tools. There are endless types on the market, but strangely enough, relatively few of them are satisfactory—at least that has been my experience. Perhaps I am unduly particular, but half the satisfaction in pruning comes from having a pruning knife or shear or saw that will do its work in a workmanlike manner. A large knife is to be preferred, one with a large and quite hooked blade. Personally, I use a knife very little, preferring a good shear, but there are occasions when a knife will do the work better than anything else. In selecting a shear, buy a good one; that always pays in the long run. $1·00 to $2·50 is well spent for a really good shear. The so-called "French Wheel-Spring Shear," which can be had at any first class hardware store, is the type I have used with the greatest satisfaction. Some people object to a shear on the ground that it bruises the

wood so. It does if you have a poor, dull affair; possibly the best of shears will to a limited extent, but only a very little, and this is much more than offset by the greater danger of shaving into other parts of the tree with a knife after the particular branch we are working on has been cut off. A shear is also usually much more convenient to work with.

The last item in our equipment is a saw. Here we are even worse off than with shears. There are almost no good pruning saws on the market. Here again perhaps I ought to plead guilty to being particular, but I want a saw of good steel which is adapted to the particular work I have in hand, and usually I cannot get it. The situation is so bad that I have had saws made for me on special orders, and three of these saws I want to describe. For heavy work we use a saw of the following specifications:—26 inches long, 6 inches wide at the butt, 1 inch wide at the tip, and 5 teeth to the inch. We have this made of No. 12 steel, the best on the market. This saw has what is called the "regular" handle. For work on bearing trees which have been well cared for, that is where there will be no very heavy work, we use the following saw —24 inches long, 4 inches wide at the butt, 1 inch at the tip, 5½ teeth per inch. For small work we use a saw with the following specifications—15 inches long, 3 inches wide at the butt tapering to a point, with 7 teeth per inch. The last two saws have what is known as a paragon handle. With such an equipment one is ready for any type of work, and it is a pleasure to do it.

SEASON FOR PRUNING.

The question of when to do the work is sure to come up and like most other questions depends on circumstances. As already explained there is some difference in effects of pruning at different seasons, but barring this consideration it is my opinion that it makes little difference when we do our pruning. Pruning during the dormant season has two very definite advantages: (1) One can see the shape of the tree much better and (2) there is usually more time for the work. If one is looking for the *ideal* time in which to do this dormant pruning, I should say the last of March or first of April. The wounds have then but a short time to stand before healing begins and one has all the advantages of the dormant season. On the other hand when one has much work to do I consider it entirely allowable to begin in December or even in November. Don't be afraid of pruning while the wood is frozen, at least not so far as the well-being of the tree is concerned.

A maxim of good pruning which is more frequently violated than almost any other is the admonition to cut close to the main branch, to leave no stubs. The proper method requires little if any more work than the wrong one, and yet men usually persist in leaving more or less of a stub when removing a branch, and the stub is always fatal to the best healing of the wound. If the branch is of any considerable size cut it off twice, once a foot away from the tree (to get rid of the extra weight), and then cut it again right in line with the line contour of the branch from which it is removed.

DRESSINGS FOR WOUNDS.

Another question of considerable practical importance, and one which is always asked when pruning is up for discussion, is what treatment the wounds ought to receive. If they are at all large, say anything above an inch in diameter, they ought to be treated with some dressing. The ideal dressing should be durable, harmless to the tissues, a good preservative, cheap, and

easy to apply. Unfortunately the ideal dressing does not exist. In actual practice we have to choose between paint, which is harmless to the tissues of the tree but not a very good preservative, and tar or creosote, which are much better as preservatives but damage the tissues. Personally, I have used the latter on very large wounds where it was necessary that the tissues be preserved for a long time before we could expect that the wound would be healed, and have used paint on all smaller wounds.

Ready-mixed paint should be avoided since it usually contains turpentine or some similar substance that will strike deeply into the tissues and destroy them. The best type of paint is plain white lead and oil, to which a little lamp black or raw sienna may be added to take away the glaring white.

With the foregoing plans and specifications in mind one may sally forth well equipped for his pruning campaign. But the fun of the thing comes from the fact that each new tree is a new problem to be thought over and solved on slightly different lines from every other tree.—TRANSACTIONS OF THE MASSACHUSETTS HORTICULTURAL SOCIETY.

MANURING OF CITRUS TREES.

Some important manurial experiments have been carried out in Porto Rico with oranges and grape fruit, and the results are published in BULLETIN No. 18, of the Agricultural Experiment Station. The response to manuring was very prompt, and the effect pronounced on both trees and quantity of fruit produced. The weight of fruit per tree harvested from the controls was but 27 per cent. of that from the trees given a complete fertilizer. The fruit ripened earlier in the control plots than in the manured plots. The following are the general conclusions arrived at:—

The theory that fertilizer requirements for a plant may be determined definitely by the chemical analysis of the soil in which it is growing has been abandoned, as the food elements may be present in abundance, but insoluble or too slowly available to the plants for their support. The analyses of the orchard soils where these experiments were done are, however, of unusual value, as they show the actual quantity of food elements in the soil which may become available for the trees, and that these elements are present in such small quantities that a thrifty profitable orchard could not be maintained without the addition of a fertilizer.

It would be impossible to give a formula which would provide for the fertilizer needed in all orchards in Porto Rico, although the results of the experiments under consideration point to one which may be recommended for those having like conditions. As the weather conditions in the citrus growing sections on the north side of the island are almost uniform, this will include localities where the soil is of a rather compact, red, sandy clay, or red, sandy clay loam. Practically all the land in the citrus-growing sections on the north side of the island except the sandy beach land answers this description. For trees of the age of those in the experiment at the time the harvests were recorded, a fertilizer formula providing for 3 per cent. nitrogen, 12 per cent. phosphoric acid, and 12 per cent. potash is recommended. This formula is suggested for use until the exact needs in individual localities are determined. For older trees which have passed their maximum annual growth, it would probably be economical to decrease the nitrogen content slightly.

The quantity of fertilizer required varies with the age and general conditions surrounding the tree, but the experiments indicate that for trees six to eight years old, which are producing good crops, 20 lb. per tree should probably be the minimum. Much larger quantities have been applied in Porto Rico with good results.—THE AGRICULTURAL NEWS.

SPICES.

A DISEASE OF CINNAMON.

A bark disease due to fungus known as *Pestalozzia palmarum* (responsible for the Grey Blight on coconuts) is reported from the F. M. S. MR. SHARPLES, writing in the AGRICULTURAL BULLETIN of that Colony, describes it as first causing the death of individual branches and then involving the whole bush. The diseased cortex is found to be dark brown in colour and on splitting open the wood, the outer layers show a dark-grey colouration about $\frac{1}{8}''$ deep. The fruiting bodies are found in the rotting tissues of the cortex and on these tissues completely decaying the spores become liberated. It is recommended that the diseased branches well below the affected parts should be cut off and burnt immediately.

CULTIVATION OF CHILLIES.

The chillie crop is cultivated throughout the Bombay Presidency, but the area in the Deccan and Karnatak is much greater than in Gujarat. The profit which the crop may yield when carefully grown, and the constantly increasing demand for the product renders it worthy of attention on the part of those who are anxious to improve the returns from their holdings.

VARIETIES.

There are a number of varieties of chillies, the principal ones being short and long. The former are generally sold green while the latter are allowed to ripen on the plants before harvest. In the long variety there are again two kinds, one with thick skin while the other has a thin skin. The one with thick skin is considered less pungent than the other. The Goa variety belongs to this class. There is a third variety called *Lavangi* which is very small, at the most $\frac{3}{4}$th of an inch long and about $\frac{1}{8}$th of an inch thick. This is very sparingly grown in the Deccan and also to a small extent cultivated as an irrigated crop on *besar* soil in the neighbourhood of Surat. This is very pungent. A variety resembling the tomato in shape is very common in the Dharwar and Belgaum districts. It is less pungent and is generally used as a vegetable.

SOIL.

Chillies may be grown as a dry crop on medium black soil and also on the *goral* soil of Gujarat and *Malai* (deep loam) land on the banks of the big rivers. Dry crop cultivation is extensive where the rainfall is well distributed. Such conditions are obtained in parts of Dharwar, Belgaum and Satara districts, and therefore large areas are annually put under chillies without irrigation. The area under this crop is 50,000 acres in Dharwar and 20,000 acres in Belgaum. As an irrigated crop it is grown on lighter descriptions of soil, but in Khandesh even black soil is used for the irrigated crop.

TILLAGE.

The land should be ploughed deep and harrowed several times to get a fine tilth. For dry crop a handful of well rotted farmyard manure or town sweepings is put at the bottom of each plant at the time of its transplanting. In the case of an irrigated crop the manure is mixed with the soil; but in East Khandesh the farmyard manure is usually given by handfuls in three dressings. It is advisable to spread the manure before ploughing so that it gets well mixed with the soil. The usual rate of application is up to twenty loads of farmyard manure or town sweepings per acre. For the irrigated crop either flat beds or furrows and ridges are made to facilitate irrigation. In Khandesh and Gujarat beds are made after the cessation of the monsoon.

THE NURSERY.

High land should be selected for the purpose of raising the seedlings of chillies. It should be well dug, and levelled for the purpose, and formed into small beds, six feet by three feet in size. A basket of farmyard manure or poudrette is then thoroughly mixed with the soil of each bed, along with a basket of ashes. Seedlings from twenty such beds will be sufficient to transplant an acre. $2\frac{1}{2}$ roalas of seed is needed for each bed, i. e. $1\frac{1}{4}$ pounds for twenty beds. The time best suited for raising the seedlings is before the beginning of the monsoon, and they should be ready for planting by June 15th. Hence the seed should be sown early in May (*Vaishakh*). The seed should be thoroughly mixed and lightly covered with the soil, the beds then pressed and watered lightly daily in the morning and evening. The seed beds are generally covered with toddy leaves, turf and cotton stalks, etc., in order to conserve moisture and protect the delicate seedlings from the heat of the sun in their early stages.

TRANSPLANTING

The seedlings will be ready in about four to six weeks. They will be eight inches high, and the transplanting should be done on a cloudy day or in the evening. The distance between the plant should be $1\frac{1}{2}$ to 3 feet according to the nature of the soil and treatment. To ensure the planting being done at equal distances, a rake (*dantali*) should be prepared, having three or four teeth at the required distance, and the line marked out with this in both directions so as to form squares, or a long string should be used for each line, having marks placed at the distance needed, and the points thus fixed. Holes should be made with a small pointed stick at each place, and two plants placed in each hole. If the crop is to be irrigated it is recommended that ridge and furrow should be made in preference to flat beds and then the seedling should be transplanted on the sides of the ridges.

ROTATION AND MIXTURE.

Chillies are considered to be a good preparation for all crops. In Khandesh chillies are grown continuously for several years on the same land. Chillies may be grown as a mixed crop with ginger, turmeric, potatoes, onions, brinjals and the like crops, and the methods are the same as when the crop is grown alone under irrigation.

AFTER TREATMENT OF THE CROP.

Regular interculture is necessary after transplanting to move weeds and to loosen the soil. In dry crop cultivation the bullock hoe is worked both lengthwise and crosswise. If the rain is satisfactory there is no need for

irrigation in any case until October, and not often even after October if the late rains are favourable. The weeding must be done by the weeding hook or the Planet-Junior hand hoe, which is found to be very satisfactory where the bed system is adopted. A top-dressing either of farmyard manure or of castor cake (300 to 500 pounds per acre) should be given in September to an irrigated crop. This will increase the number of flowers and hence the amount of fruit In Khandesh, Nasik and Gujarat plants are earthed up to prevent lodging after top-dressing. If irrigation be adopted, watering should be given at intervals of ten to fifteen days, after the rains are fully over, the interval being determined by the texture of the soil. Overwatering does great damage and spoils the fruit.

HARVESTING.

Three months after transplanting the first picking is ready. There are usually three to five pickings of the crop when grown without irrigation, and more when irrigation is employed. The chillies after picking are dried in the sun, and then marketed. A very common disease which this crop is subject to is malformation or curling of leaves called *khokada* in Khandesh and this, if it once spreads, materially affects the outturn. The remedy adopted by the cultivators is to temporarily withhold water and expose the soil for aeration by ploughing the intervening space.

COST OF CULTIVATION AND OUTTURN.

The whole cost of growing the crop, including the cultivator's labour, is about Rs. 40 per acre for the dry crop and Rs. 75 to Rs. 175 per acre when grown with irrigation. The outturn of dry chillies varies from 750 to 1,000 pounds per acre with the dry crop, to 1,200 to 2,000 pounds per acre with the irrigated crop. The average value of dry chillies to a cultivator is about 12 pounds (6 seers) per rupee, and hence the money return may vary from Rs. 60 to Rs. 160. The general results are shown as follows :—

CHILLIE CROP.

	Total cost of production.	Outturn.	Return from crop at 6 seers per rupee.
Dry crop ...	Rs. 40 ...	750 to 1,000 ...	Rs. 62 to 83
Irrigated crop ...	Rs. 75 to 125..	1,200 to 2,000 ...	Rs. 100 to 166.

The actual return to a cultivator is much more than this as he uses his own labour in raising the crop.—AGRICULTURAL AND CO-OPERATIVE GAZETTE.

In connection with the question of potash for agriculture the bi-products in sugar manufacture are mentioned as a likely source. A writer in the WEST INDIAN AGRICULTURAL NEWS places a high value on the potash and nitrogen contents of molasses.

SOILS AND MANURES.

THE WORLD'S SUPPLY OF POTASH.

W. A. D.

In view of the scarcity of potash occasioned by the war, the Imperial Institute has issued a pamphlet (pp. 47, price 1*s*) under the above title, in which a review is given of the existing sources of supply and suggestions made as to the possibility of obtaining potash from materials not hitherto worked for this purpose. The potash used in this country has been almost exclusively derived from the Stassfurt deposits, south of Magdeburg, which have been so systematically and economically worked since about 1862 that German potash, on account of its cheapness, has driven all other competitors from the market. Potash salts are essential constituents of plant food, and the greater part of the potash salts extracted at Stassfurt is used as a fertiliser; but relatively large quantities are employed in various chemical industries and in the manufacture of glass and soap.

Besides the Stassfurt deposits, there is only one extensive deposit of carnallite at present known, and that is the Spanish deposit of Catalonia, the working of which, it is stated, has recently been commenced. This deposit has great commercial promise, and, next to those of Stassfurt, may prove to be the most important source of potash at present known. There are also deposits in India, which may prove to be of importance if they can be worked sufficiently cheaply.

All plants contain more or less potash, and the utilisation of the ash of wood, the ash of sea-weeds, of beet-root residues, and similar by-products of industries in which vegetable raw materials are employed, is of importance as a source of potash, especially at a time of scarcity like the present. The burning of seaweed and the extracting of potash from the ash, at one time an important industry on the coasts of Scotland and Ireland, has recently shown signs of revival. From Ireland during 1913, 3,939 tons of kelp, valued at £16,631, were exported. As a rule the Irish kelp contains more potash than that produced in Scotland. At the present time the utilisation of the giant kelps of the Pacific coast is regarded by many as the most promising source of soluble potash salts in the United States. The best account of the new industry which has sprung up on the Pacific shores was given by F. K. CAMERON in a paper read before the Franklin Institute in 1913 (JOURN. FRANKLIN INSTITUTE, Vol. clxxvi., p. 347). According to an official estimate 6,000,000 tons of potassium chloride could be obtained annually from this source. It was shown by BALCH in 1909 that the giant algæ of the Pacific, the principal species being Nereocystis and Macrocystis, contain about five times as much potash as the majority of seaweeds, the average percentage on the dried weed being from 15 to 20 per cent. of K_2O. Since the publication of these results various labour-saving devices have been tried for cutting and collecting the weed, and the cost per ton of weed not landed is stated to be about 20 cents.

The preparation of potash salts and iodine has also become an important industry on certain parts of the coast of Japan, and it is stated that Japan now supplies about 80 per cent. of the iodine consumed in the United States. The weeds used on the coast of Japan are species of Laminaria, *Ecklonia cava*, *E. Bicyclis* and Sargassum, spp.

In Canada the burning of wood to ash was for several years a considerable source of potash, but in a report recently issued by the Forestry Branch Department of the Interior, it is stated that at the present day, owing to altered conditions, there is small possibility of reviving the potash industry as formerly practised. The amount of potash to be recovered from the waste from the sawmills is considered to be too small to be regarded as commercially practicable for the mills to undertake its recovery. In most cases the only use for the ash from sawmill burners is for the farmers in the locality to apply it directly on the land.

Experiments made at Rothamsted recently have shown that the ash of hedge cleanings, consisting of grass, weeds, and clippings, contained on the average about 11 per cent. of potash, that is to say, about as much as kainit (RUSSELL, JOURN. BOARD OF AGRIC., 1914, vol. xxi., p. 694). The potash is present in a very soluble form (carbonate) and is rapidly washed away. If it is to be utilised, therefore, care must be taken to protect the ashes from showers of rain while they are cooling.

A rather neglected source of potash is the soapy water used for removing grease from wool. The matter soluble in water contains potash equivalent to 5 per cent. of potassium carbonate, calculated on the raw wool, but as the recovery of potash is not remunerative unless conducted on a large scale, the wool washings are usually allowed to go to waste. On the other hand, in Belgium, France and Germany the wool suint is utilised as a source of potash ; it is estimated that in the Roubaix district alone potash salts to the value of £100,000 are obtained annually from this source.

One of the most promising future sources of potash supplies seems to be the recently discovered deposits in Alsace. In 1904 deep borings were made at Niederbruck in the hope of striking oil, but instead saline matter was encountered at the depth of 1,174 feet. Since then the number of mines has increased to twelve: in 1912 the output was 137,243 metric tons, and in 1913, 350,341 metric tons. Recent reports state that the Alsatian deposits are probably continued across the Rhine into Baden.

During the past few years attention has been directed to the possibility of employing as manures, with or without previous treatment, minerals which contain potash in an insoluble form ; the more important of these are alunite, felspar, and leucite. An account is given in the pamphlet of the methods which have been experimented with.—NATURE.

ORGANIC *VERSUS* INORGANIC MANURES.

The history of science offers no more instructive or interesting chapter than that which records the growth of knowledge in the principles of manuring land. While from time immemorial the gardener has been content to use on his land as much good farmyard or stable manure as he could obtain,

there have been periods when the agricultural chemist has urged that this faith in dung was excessive, and has maintained that a judicious outlay on artificials would result in crops at least as large as those obtained by the use of manure, as well as in a saving of money.

Nevertheless, the gardener went on using the product of stable or barn, and ignored the teaching of the chemists.

Now we learn from MR. HODSOLL, who lectured at the Royal Horticultural Society meeting on 31st ultimo [August] on the respective values of organic and inorganic manures, that there is much justification for the gardener's prejudice in favour of organic manures.

By organic manure, in contradistinction to inorganic, MR. HODSOLL means not only farmyard and stable manures, but any other waste products of animal or plant life—dried blood, fish manure, guano, rape dust, shoddy, and the like.

He points out that the actual market price (per unit of ammonia) of dried blood is 15 or 16 shillings, whereas that of sulphate of ammonia (an inorganic manure) is per similar unit 12-13 shillings; and he asks the pertinent question, why is the cultivator content to pay more for the one than the other if the amount of nitrogen is the same in both? Not so long ago the chemist would have maintained that sulphate of ammonia was to be preferred; urging in justification of that view that the high degree of solubility of the inorganic nitrogenous manure was a great point in its favour. Nevertheless it would be unjust to the chemists to claim that their conversion to a belief in organic manures is due to the gardener's practice. They have worked out—or are working out—their own salvation, and the results of experiments carried on for years at Rothamsted have been important elements in provoking their change of opinion. Thus in one series of experiments with Mangels it was found that whereas a complete manure of superphosphate and potash with nitrate of soda gave 18 tons per acre and roots to the number of 14,130, a similar dressing of superphosphate and potash, but with rape dust in lieu of nitrate of soda, gave upwards of 21 tons per acre and roots to the number of 17,474.

A similar advantage in favour of organic manure is shown in the results of another series of Rothamsted experiments in which phosphates were given in different forms, namely, as superphosphate, basic slag, and bone meal. In all cases—with Swedes, Barley, and Wheat—the best result was obtained with bone meal.

The conclusion seems clear. Since the difference between organic and inorganic manure lies in the fact that the former contains humus and that the latter does not, the superior results due to the organic manures must be attributed to the beneficent action of the humus.

Now that action is of several kinds—mechanical, chemical, and biological.

The effects of humus on the mechanical conditions of the soil are well-known. Clay is flocculated by it, and, in consequence, becomes more open; sand, on the other hand, becomes more retentive of water.

The chemical value of humus is understood only in a general way. It is composed of a large number of compounds of nitrogen and other "plant foods," and these compounds presently become available to the plant. The

biological effect of humus is no less, and perhaps more, important; for that substance serves as a store food for bacteria, and the latter in the process of living break down the humus into compounds which are capable of being absorbed by the roots of plants.

It is furthermore suggested by certain American investigators that a disadvantage inherent in the use of inorganic manures is that they render the soil uncongenial to beneficent soil bacteria, and hence arrest in a measure the processes of decay which must take place in every fertile soil.

Nevertheless, it must not be thought that MR. HODSOLL would advocate the exclusion of inorganic manures from our gardens, but that rather they should be employed in conjunction with organic manures, and particularly those containing potash and phosphates. For, as is well known, although the use of such manures alone on poor land is productive of little good, their use in conjunction with dung leads to admirable results.

Yet another advantage of organic manures is shown by the Rothamsted records, in which the effects of dung are shown to persist for many years, whereas the residual value of inorganic manures is soon lost.

The main conclusion is clear: organic manures in one form or another are essential. If sufficient dung cannot be obtained recourse must be had to other forms of organic manure, of which many are on the market. If sufficient supplies fail the gardener, he must, and should, resort to the practice of green manuring. More might be done in this respect, and we should like to see an autumn crop of Mustard or Tares sown in the vacant land of every garden. Worked in rotation, now on this quarter and now on that, and dug in in the autumn, it would help to a very considerable degree to keep garden land in good heart.—THE GARDENERS' CHRONICLE.

SOIL EROSION.

BULLETIN NO. 53 OF THE AGRICULTURAL RESEARCH INSTITUTE at Pusa deals with this subject which is of very great importance from a local point of view, and any information as to how the resulting loss could be prevented would be very welcome.

MR. ALBERT HOWARD, the author of the bulletin referring to the methods by which erosion could be prevented, says that both erosion and water logging take place because the run-off is not checked but is allowed to gain volume and velocity on its way to the drainage lines. According to him it is necessary to harness the monsoon and to deal with it on the principle of *divide and rule*. It is of course a distinct advantage to cultivate the soil pretty deep so as to increase its absorbing power. The two means recommended are (1) embankment and (2) surface drainage.

The embankment system is seen at its best in Italy where it is combined with a drainage and irrigation system for the distribution of the water. The object should be not to allow the water which is caught to stand for any length of time but to distribute as quickly and advantageously as possible. The surface drainage system recommended by Pusa has proved very effective and is being adopted by many estates in Bihar. The method consists in dividing up the country into areas of from five to ten acres and surrounding

these with trenches, the borders and sides of which are turfed to prevent cutting. The field trenches communicate with larger channels which carry the run-off either to the low-lying rice areas or to streams and rivers. The size of the field trenches will vary according to the amount and distribution of the rainfall. In Bihar, it has been found that channels four feet broad at the top, two at the bottom and eighteen inches deep, suffice in most cases. A grass strip, about a foot wide, should be left on the field on each edge of the trench to prevent breaching by the run-off and it is an advantage to let the grass grow on the sloping sides as well. The roots consolidate the soil and, after the first year, there is little trouble from breaches. A good deal of attention is necessary during the first monsoon in repairing the edges and in checking cutting. It is best to dig the trenches in the hot weather and to plant the sides and edges with *dub* grass on the early rains. During the monsoon, the trenches silt up to some extent and it is necessary to clean them out every hot weather, the soil being placed on the down side. By this method each field deals with its own rainfall only and water-logging is prevented. The border on the lower edge of the field becomes raised by the growth of the grass an inch or two above the level of the land and by this means a large quantity of the silt is deposited before the surplus water runs off. The grass borders continue to raise themselves automatically as silt becomes deposited on the lower portions of the fields. Any small depressions in the plots soon become filled up with silt and areas surface-drained in this manner soon assume an exceedingly even appearance. The aim of the method is to keep the fine silt on the land, a matter which was referred to at the recent Sanitary Conference at Lucknow by the HON'BLE MR. HUTTON, Chief Engineer and Irrigation Secretary to the Government of the United Provinces, in the following words:—'I am firmly convinced that the problem to be solved in many parts of these Provinces and over a considerable part of India is not that of capturing the silt after it has found its way into our torrents and rivers but to *prevent it getting there.*

In carrying out the Pusa system in practice, a drainage map is essential. This can best be obtained by marking on an ordinary map the direction in which rain water runs off the land. This enables the drainage lines to be determined far more easily and cheaply than by any system of taking levels. Once the drainage lines are known, the drains can be laid out to the best advantage, both from the point of view of the prevention of erosion as well as from that of surface drainage. Where the slope is considerable, the cross drains must run parallel to the contour lines and somewhat close together. The fields then become long strips.

FARM-YARD MANURE.

R. T. McKENZIE.

It is a notorious fact that many farmers under-estimate the value of farm-yard manure, with the result that much valuable fertilizing material goes to waste every year on the farms of this State. It is no uncommon sight to see great heaps of manure, the accumulation of many years, lying about without any attempt made to put same to profitable use. In fact, in some

cases it is looked upon as a nuisance, the farmer being content with getting it away from the proximity of his milking sheds and other places. In cases where farmers do make an endeavour to utilize the farm-yard manure, their efforts are, to a large extent, neutralized by faulty methods of storage. They are, for the most part, ignorant of the fundamental bacterial changes which manure undergoes subsequent to being voided by the animal. It is in extremely rare cases that any attempt is made to save the liquid manure; yet this is by far the more valuable of the two, as analyses from American sources indicate, viz:—

	Nitrogen.	Phosphoric acid.	Potash.
Solid horse manure contains	·495	·13	·200
Liquid horse manure contains	1·20	trace	1·24
Solid cow manure contains	·324	·09	·124
Liquid cow manure contains	·95	·013	·79

The above table demonstrates that the liquid excrement is much richer in plant food than the solid; consequently every effort should be made to retain it. Once, farm-yard manure was practically the only manure used; this was prior to the advent of the artificial fertilizer, which is applied in a way that is easily assimilated by the soil, and makes its effect immediately apparent. But with farm-yard and organic manure it is not until they are decomposed that the beneficient results are manifested.

The great advantage that organic manure has over artificial fertilizers is that, besides furnishing plant food, it improves the physical, chemical, and biological nature of the soil, by increasing the humus. It is this humus in the soil which has the faculty of absorbing water quickly and arresting evaporation, and makes the soil in which humus is abundant more retentive to moisture. Humus in soil can be increased by the addition of farm-yard and other organic manure; hence the importance of the proper care and use of farm-yard manure. The primary factor to be considered in storage of manure is the control of fermentation, which causes the decomposition.

There are two processes of fermentation, namely, that caused by ærobic bacteria, which cannot live or have their being without access to the air, and anærobic bacteria, which flourish and develop only when atmospheric air is excluded. It is the first class of bacteria that causes the extreme heat, which is very undesirable, inasmuch as the heat liberates the nitrogen, the most valuable element. It also incidentally destroys the humic acid. The conditions favourable for the development of ærobic germs are when the manure is loose and contains little moisture. Anærobic fermentation, on the other hand, is carried on best when the manure is compacted and moist, thereby preventing the incursion of air, so that decomposition is carried on without any great heat, thus preventing the loss of nitrogen and humic acid. It is obvious, therefore, that the farmer should store manure, in such a way as to prevent ærobic, and encourage anærobic fermentation.

This cannot be done under the present haphazard fashion of piling manure. A good method of storing manure is to build a brick or concrete pit of sufficient size to meet the requirements of the farm, making provision for the catchment of the liquids.

Another inexpensive method is to make a compost heap, where the manure is spread in layers until the needed size is reached, a few inches of

soil being thrown on to exclude the air. Provision should be made for the catchment and return of the seepage water to the heap.

Another good method, where practicable, is to apply the manure in a fresh condition straight from the stable or byre, spread in narrow strips, which should be ploughed in about once a fortnight.

If farm-yard manure is conserved in some such way, it will be of much greater value than when allowed to accumulate in the present loose fashion.—

JOURN. OF AGRIC., VICTORIA.

SOIL VENTILATION.

A. HOWARD AND G. L. C. HOWARD.

The alluvial soils of the Indo-Gangetic plain in India are characterised by a fine even texture and by the faculty which their constituent particles possess of running together to form a hard crust or cement after heavy rains or irrigation. This latter property, combined with the fact that in many parts, when the monsoon is at its height, the water table may rise to within a few feet of the surface, makes the proper ventilation of the soil a somewhat difficult matter. A considerable amount of evidence is brought forward to show that the crops in these regions frequently suffer from asphyxiation. Such crops exhibit various signs of loss of vigour which are usually interpreted by the native cultivators as an indication that more irrigation water is required, with the result that the condition of the crop is merely aggravated by continued waterings. On the other hand, experiments have now proved that immediate benefit is derived when measures are taken to break up the crust and ærate the soil to as great a depth as possible.

In other parts of India, as for instance the Quetta Valley, where similar kinds of soils are found under totally different climatic conditions, soil æration has also been shown to be deficient, though in this case there can be no lack of drainage and the harmful effects must be attributed solely to the impermeable crust formed on the surface of the land.

The necessity for æration is still more marked where green manuring is practised, and a great similarity may be noted between the harmful effects produced by ploughing in green vegetable matter and those observed when fruit trees are planted in grass land. It is therefore suggested that there exists a connection between the two phenomena, i.e., the excessive production of carbon dioxide, which becomes deleterious when it forms too large a proportion of the soil atmosphere.

Over and above having discovered the cause of much damage to crops the writers, in showing the part played by soil æration on all irrigated lands, have indicated a means of economising water and thus extending the benefits of irrigation over a larger area of the country than was thought possible.—

BULL. INT. INST. OF AGRIC.

THE STORAGE AND USE OF SOIL MOISTURE.

W. W. BURR.

These bulletins* report experiments carried out during 1907 to 1912 at the Experimental Sub-Station of Nebraska at North Platte, in collaboration with the Bureau of Dry-Farming and the Bio-physical Laboratory of the Bureau of Plant Industry of the United States Department of Agriculture.

The object of the experiments was the study of the problems concerning the accumulation and use of soil water. The soil used was a silty sand, or loess, and the subsoil conditions such that the crops depend absolutely on the rainfall, which averaged 18·6 inches (472 mm) during 1875–1912; June has the highest monthly average and January the lowest. These facts should not be lost sight of in considering the following results.

The maximum quantity of water retained by this soil under cultivation varies between 16 and 18 per cent. of its dry weight; the minimum content at which crops can still obtain water is about 7 or 8 per cent.; in other words the soil water above 7 or 8 per cent. of its dry weight is available for plants. Summer fallow is the most effective means of accumulating water in the soil and the relative quantity of this depends upon a number of factors, viz., the nature and distribution of the rainfall, the efficiency of the cultivation and the presence or absence of a crop. At the North Platte Sub-Station, in a period of six years the soil accumulated from 6 to 33 per cent. of the rainfall each season and in favourable years the soil was practically saturated to a depth of 6 or 7 feet. With regard to the storage of water in the soil, the distribution of the rainfall is just as important as the quantity; water accumulates more rapidly when the rains are sufficiently frequent to maintain the surface of the soil damp during the intervals. One inch of rain falling on a very dry surface rarely moistens more than 6 inches, whilst a fall of half an inch is only stored if the soil is already damp from previous rain. Water passes more rapidly through a damp than through a dry soil. A cultivated soil retains water better than an uncultivated soil; and this difference is greater in proportion as the rainfall is heavier. Ploughing is more efficient than disc harrowing in accumulating water in the soil; disc harrowing is more successful on a stubble in destroying weeds and in stirring the surface soil; but a mulch of several inches of hay or straw is still more efficacious in storing water.

Maize, oats, spring wheat and barley use the soil water to a depth of 4 or 5 feet; winter wheat uses water to a depth of 6 or 7 feet; maize sown in rows and hoed uses less water than other cereals.

Plants appear to extract the water from the soil by developing their roots in the moist soil: capillary movement appears to play only a small part. Under normally favourable conditions vegetation in an active state of growth is a more important factor than surface evaporation in removing the water from previously saturated soil. Weeds are often the most active agents in consuming the soil water and in preventing its storage in the soil for the benefit of other plants. A 3-inch straw mulch is the best means of diminishing surface evaporation during prolonged drought. In these particular soils lucerne when once established utilises the water to a depth of 20 to 30 feet.

* Agric. Expt. Stn. of Nebraska. Res. Bull No. 5 & No. 140.

Capillarity is a useful means of supplying the water requirements of plants within certain limits when water is available; for instance, it may be an important factor when the water table is just at the lowest limit reached by the roots of the crop. But the water-table may be too low for capillarity to supply the roots, as in the case of the high lands of Nebraska.

According to these researches, the production of 1 lb. of dry matter of wheat, rye, oats and barley requires twice as much water in an unfavourable as in a favourable season. Unfavourable conditions to these cereals do not necessarily constitute an unfavourable season for maize, as its chief growing-period is so much later.—BULL. INT. INST. OF AGRIC.

INJURIOUS ACTION OF HEAVY DRESSINGS OF LIME ON MOOR SOIL.

The object of these researches was to determine whether there is any connection between liming and certain injurious transformations of nitrogen, on moor soil. That this should depend upon an injurious effect on the biological activity of the soils in question would seem to be contradicted by the fact that in no case did application of lime decrease the activity of the soil.

With regard to a possible reduction of the soil nitrates to nitrites, experiments made with different samples of limed and unlimed peaty soil showed no chemical decomposition of the nitrates. A solution of nitrate inoculated with extracts of heavily limed moor soil gave no chemical reaction that could decompose the nitrate. On the other hand, it would appear that the formation of nitrites from nitrates depends upon temperature, small differences in the latter causing considerable modification in the reduction of the nitrates: this would be a corroboration of the biological nature of the reduction of nitrates in limed moor soils. In any one group of moor soils, the micro-biological formation of nitrites due to heavy liming increases with the degree of decomposition of the soil. The soil of fens shows a greater power of producing nitrites than that of upland moors. Such applications of lime as do not remove the acidity of the moor soil bring about no perceptible reduction of the nitrates; but applications that give to the soil a neutral or alkaline reaction induce a formation of nitrites. In the acid soils of high moors, nitrites are rapidly decomposed, owing to a double reaction between the nitrous acid and the peat; in soils neutralised by the application of lime, a chemical decomposition of the nitrites is not observed, the process being brought about solely by micro-organisms.

The first phase, therefore, in the decomposition of nitrates in moor soils is their reduction to nitrites by microbic activity; then the chemical reaction between nitrites and the peaty substances results in the complete breaking up of the nitrous acid; part of the nitrous nitrogen is lost in the soil and, of the remainder, part is transformed into ammonia or amide compounds, and part is present as organic nitrogen.

The denitrification experiments lead us to conclude that the conditions unfavourable to bacteria obtaining in the soils of unlimed upland moors of acid reaction, hinder the bacterial decomposition of nitrates; in neutralised soil, on the contrary, a rapid breaking up of the nitrates takes place, together with great loss of nitric and total nitrogen. These great losses of nitrogen are in relation to the amount of lime applied.—BULL. INT. INST. OF AGRIC.

DETERMINING THE CAPILLARY PULL OF SOILS.

W. A. CANNON.

By this method the capillary pull is measured by the reduction in pressure in the closed arm of a manometer connected with the soil container.

The apparatus consists of a 'T' shaped glass tube having a threeway cock, and of a mercury manometer, a reservoir and a soil container, each of which is connected to a limb of the cock by means of a rubber tube. The reservoir is filled with water and the stop cock adjusted so as to allow all the tubes and connection to fill with water. A small plug of cotton wool is placed in the bottom of the soil container to prevent the escape of the soil.

The container is filled with soil and the stop-cock turned so as to connect it with the reservoir. The levels of the container and reservoir are adjusted so that water flows into the container and the soil is stirred with a small glass rod to prevent the collection of air bubbles. When the soil appears to be uniformly settled the cock is turned so as to cut off the flow of water from the reservoir and to connect the container with the manometer. The position of the mercury is then observed, the uppermost point reached by the mercury being considered the measure of the capillary pull of the soil under the conditions of the test.

The great objection to this method is the difference in the compactness of the soils when placed in the container. This error is reduced to some extent by the settling under water and can be still further minimised by repeating the tests.—BULLETIN INT. INST. OF AGRIC.

According to the note in the EXPERIMENT STATION RECORD the effect of loranthus is to bring about a high rate of transpiration of water from the host plant through the partial parasite. Observations made in Java showed that the daily loss of water per unit of leaf surface of the parasite is about 50 per cent. greater than that of the host—in this case a mango tree. The same relation was observed in the case of a guava tree. This high rate of transpiration is thought to be accountable for the desiccation and death of the region in which the parasite establishes itself.

FOOD PRODUCTS.

PROPAGATION OF ONIONS.

There are three recognised methods adopted for establishing a crop of onions:—

1. By sowing seed in a prepared bed and transplanting into permanent positions.
2. By sowing seed in rows where the plants are to mature.
3. By means of sets.

The first method is the one usually adopted under West Indian conditions, and taking everything into consideration, it is undoubtedly the safest method in normal seasons. It will be convenient to consider this method first.

SEED BEDS.

Seed beds should be carefully prepared during the month of July, so that they will be in a fit condition to receive the seed immediately on arrival. They should be made in a selected and fertile place near a supply of water, and the soil must be mellow and well drained. The ideal site for such a bed is in a position that possesses protection from wind; it is also a good plan to have placed around the beds strong stakes from which ropes are stretched so that protection from heavy rainstorms can easily be provided by means of canvas or cloth.

The beds should be raised about 18 inches above the surrounding land so as to ensure good drainage, and they should not exceed five feet in width. Care should be taken not to sow the seed too deeply. Drills ½ inch deep should be made, but they may be a little deeper in very sandy soil. After covering the seeds, the soil of the beds should be compressed. Some growers after sowing put a light covering of straw on the beds which undoubtedly helps to keep the soil moist and cool; but at times it is left on too long and the young plants then become weak and leggy. Good seeds germinate in five or six days' time, but sometimes three or four days more elapse before they are seen. If a straw covering is used it should be removed as the seedlings are visible.

TRANSPLANTING AND ESTABLISHMENT OF CROP.

The operation of transplanting small seedlings is performed at times in a manner far from satisfactory, and irregular stands are often obtained. When fit for planting in their permanent positions, seedlings should be stocky and between 5 and 6 inches high; when transplanting; the roots should be trimmed, the plants placed in boxes containing soil, which should be packed tightly against the roots, and then carried to the field. Labourers are often seen carrying young seedlings about in their hands; as a result of this practice a large number of plants become wilted and limp before they are planted.

PLANTING IN SITU.

This method is one that has so far only been tried in Antigua on a small scale. It is only possible to adopt it when rains fall at the time that seed is available for planting. There are two ways of establishing an onion crop by this means: one is by sowing the seeds thinly in rows and then thinning to the required distance apart, and the other, which is merely an elaboration, is by sowing in holes made equidistant in the rows.

By the first method an experienced onion grower can sow the seeds in the drills in such a manner that little thinning out of the young seedlings is necessary. When the other is adopted two or three seeds are placed in the ground by means of the thumb and forefinger. A marked line is used so that it is not easy for the labourers to make mistakes. Careful supervision is however essential during this operation.

In Antigua it has been found that when this method of establishing an onion crop is adopted, the onions mature some weeks (about three) earlier than when seedlings are transplanted. This is a point of importance to the local grower, for as a rule the very early onions meet with little competition from produce grown in other places; consequently good prices are obtained. It must be stated, however, that contrary to experience gained in some other parts of the world, it would seem that onions resulting from seed sown *in situ*, in Antigua, are not of such good shape as those grown by transplanting from nursery beds.

PLANTING BY MEANS OF SETS.

The raising of a proportion of the onion crop by means of sets, that is to say, small onion bulbs raised in one season and planted out in the next, appears at first sight to be an easy means of growing produce for the very early markets. This method has been successfully tried on a small scale in the West Indies, sets imported during the months of August and September having matured a crop much earlier than if seeds were utilized; on the other hand, a recent trial at Skerrett's Experiment Station, Antigua, with the planting of imported sets of the Red and White Bermuda varieties failed to form bulbs, indicating that a considerable degree of uncertainty attaches to this process under West Indian conditions.

In many parts of the world the setting or planting out of onions is facilitated by the use of planting-distance indicators. By this means straight rows, which are essential to good cultivation, are obtained. Boards through which holes have been bored can with advantage be used in this connection. Through these holes round pieces of wood are thrust which make the holes for the young plants. It is quite possible that small furrows could be made by light cultivators into which the young plants could be set, and the soil made firm against them by hand. At the present time, under West Indian conditions, labourers often go into the field to plant onions without being provided with even a dibble.

The task of transplanting onions is laborious, and it will be found that although a gang of labourers will perhaps perform this operation in a satisfactory manner when watched by an overseer, it is often done in a slovenly fashion when they are left to themselves. One point which should be borne in mind is that it is not the neck, but the roots of the plant that require to be

firmly planted. It is common practice for the labourer, when tired, to squeeze the earth against the side of the plant with his thumb and forefinger, and this often leads to the loss of many young onion plants.

YIELD.

The yield of onions, which varies considerably, is usually reckoned in pounds.

In certain onion-growing districts 25,000 to 30,000 lb. per acre are obtained, but for such a crop it is estimated that the cultivation costs, at times, as much as £30 per acre.

If between 5,000 and 8,000 lb. are obtained in the West Indies it s regarded as a good return. Against this, however, the cost of production is very small. Should onions be grown as a main crop, there is every probability that returns equal to those obtained in other parts of the world would be realized by growers.

CURING.

The curing of onions consists in removing the superfluous water which they contain when reaped, and is accomplished by allowing them to dry under suitable conditions for a sufficient length of time.

Neglect in this respect is liable to lead to the spoiling of the crop after a very short time.

For their successful curing, onions require to be dried in a cool well-ventilated room on shelves constructed to secure a free circulation of air around the bulbs. In curing, the onions should be placed in single layers on the shelves and never one on the top of the other.

The time required to complete curing ranges from five to seven days, while the loss in weight, which occurs during the process ranges from 4 to 10 per cent., depending on the conditions under which the bulbs wer grown.

Curing is judged to be complete when the onions have formed a well-marked dry outer skin, which serves to prevent further loss of moisture from the interior of the bulb, and affords protection from injury.

In the past, in the West Indies, few growers have paid sufficient attention to the requirements of the crop in this respect. The most common practice has been to heap up the onions in the fields after reaping, allowing only a few hours to elapse before they are placed for export. This practice must be unreservedly condemned.

The more careful planters have, however, been in the habit of spreading their produce on the ground for a few days before shipping; the onions are turned periodically, and tarpaulins provided as protection against rain. This method is preferable to the others previously cited and answers fairly well during dry weather, but it is difficult to keep the produce dry during showery weather, and on this account this mode of working is open to objection.—BULL. No. 78, IMPERIAL DEPT. OF AGRIC. FOR THE WEST INDIES.

FOOD SUPPLIES IN TIME OF WAR.

WHAT THE NAVY IS DOING.

The President of the Agricultural Section, MR. R. H. REW, C.B., delivered an address on "Farming and Food Supplies in Time of War."

MR. REW contrasted British agriculture to-day with what it was during the Napoleonic wars. A century ago the pioneer work of JETHRO TULL, "TURNIP" TOWNSHEND, ROBERT BAKEWELL and their disciples had only recently established the principles upon which modern farming has been developed. Comparing the agricultural statistics of 1808 with those of 1914, MR. REW pointed out that the greatest contrast was in the acreage of wheat in proportion to the population, the earlier estimate giving 35½ acres for every hundred inhabitants, compared with five acres last year. The yield per acre, however, had been increased from 3 qr. to 4 qr., thus reducing the disparity to 8½ and 1½ bushels per head of the population respectively. Even at that time this country was not self-supporting in breadstuffs, the surplus of about a million quarters of wheat being derived mainly from the Continent.

Dealing with the situation at the outbreak of the present war, MR. REW quoted from the official statistics to show that the country had rather more than normal supplies of every crop except peas, roots and hay, and emphasized the fact that the war had been in progress for nearly four months before prices began to rise appreciably. The speaker commented upon the energy with which the nation set about remodelling its farming system only to discover the elementary fact that it was impossible to improvise food, the main farm crops taking an unreasonably long time to grow and the sudden extension of the area under cultivation being anything but a simple proposition. The country was suddenly brought face to face with the fact that its agricultural system had not been arranged to meet the conditions of a great European war. Having reviewed the various schemes for utilizing our resources and conserving supplies, he noted the patriotism and intelligence of the British and Irish farmers.

After showing that the share of British Agriculture in the food supply of the nation was more considerable than was commonly realized, MR. REW submitted comparative statistics of food imports, showing how our oversea supplies have been maintained during the first year of the war. In total weight of food stuffs the quantity brought to our shores was rather larger in time of war than in time of peace. Yet one still occasionally met a purblind pessimist who plaintively asked what the Navy was doing. This was a part of the answer. It was also a measure of the success of the German "blockade" for the starvation of England. So absolute a triumph of sea power in the first year of war would have been treated as a wild dream by the most confirmed optimist two years ago.

POTASH.

A paper on "The Manurial Situation and its Difficulties" was read by PROFESSOR JAMES HENDRICK. He pointed out how quickly the manure industry had grown and how large it was. The war had dislocated this great international industry in various ways. It had stopped our main supply of potash manures, which came from the German potash mines. A certain amount might be obtained at home from seaweed, but it was difficult to revive

this decayed industry quickly. Much might be done to make special potash manuring unnecessary if better use were made of liquid manure and of farmyard manure. Great quantities of potash were lost through want of proper care in saving these. If lime were more extensively used in certain districts, it would also help to tide over the potash famine.

COCONUT CAKE.

MR. E. T. HAINAN submitted a paper on "New Feeding Stuffs." He said that the stockfeeder was now called upon to grapple with a new situation. Lately prices had been rising, not on account of an actual shortage of supplies, but on account of the fact that the concentrated foodstuffs—e.g., cake—were a by-product of other industries, and the manufacturer would not put down new crushing plant for seed unless he saw a chance of making a profit The situation was improving and more plant was being put down. Discussing new feeding-stuffs, MR. HAINAN said that palm kernels had not been popular in this country, but had been popular in Germany. They now cost £7 per ton, and were economical at the price. Coconut cake was used for dairy cows on the Continent. It was said to go rancid easily, but did not if kept in a cool, dry place. Yeast had also been used for pigs with good results.

In the discussion which followed PROFESSOR WOOD suggested that the difficulty in keeping palm kernels might be due to the fact that the seed contained a fat-splitting enzyme which was killed by high temperature.

PROFESSOR SOMERVILLE, discussing PROFESSOR HENDRICK'S paper, said that the supply of potash did not cause him uneasiness because he had not found the benefit from potash which its advocates claimed for it.—LONDON TIMES.

LIMES.

Lime planting commenced in St. Lucia about 1902 and since that date 440,856 lime plants have been distributed from the Department Nurseries. The distribution during the year exceeded all previous records and coincided with the first year's work at the new Experiment Station, Choiseul.

The progress made in lime planting is indicated in the following estimated acreage under limes during 1912-14:—

Year.	Acreage.	Extension during year (acres.)	Total value of lime products exported.
			£
1912	1,900	300	1,085
1913	2,200	300	3,108
1914	2,837	637	6,451

Unfortunately, many of the earlier plantations are now showing the ill-effects of planting too closely, and thinning-out operations have commenced

on several estates. Lack of wind belts has been the chief cause in retarding the progress of many of the older estates.

The high prices obtained throughout the year for concentrated lime juice has had a beneficial effect upon the lime industry generally, both by causing an extension in the area under cultivation, and more particularly in causing greater attention to be paid to the existing plantations. Until quite recently limes were usually only planted in positions where the soil was considered by the owner unsuitable for any other crop, and their future progress was in many instances entirely left to nature. This period has passed, and lime cultivation is now looked upon with the same careful regard as cacao, and it is earnestly hoped that it will soon receive the same degree of attention.

The lime plantations in St. Lucia are in their infancy, and if profitable crops are to be obtained and maintained liberal applications of manure must be applied annually.

Although the rainfall for the year was 19 inches below the average for the last twenty-five years, the entomogenous fungi maintained complete control where conditions were favourable ; only in dry and exposed situations were trees observed to be seriously infested with scales.

The method of concentrating lime juice in steam heated evaporators has proved so satisfactory that seven such factories are now at work in the island and others are in course of erection.—REPORT OF AGRICULTURAL DEPARTMENT, 1914-15.

The influence of the soil on the prussic acid content of plants is a subject of much interest in the West Indies in connection with cassava, *Phaseolus lunatus* (coloured Lima beans) and other plants. The following results (especially par. 1,) are in accordance with those obtained by BRUNNICH and TREUB. On the other hand, SCURTI and TOMMASI in Italy found that the addition of nitrates, in the case of beans, reduced the prussic acid content :—(1) When sorghum is grown on poor, infertile soil, added nitrogen may slightly increase the amount of hydrocyanic acid in the plant. With a fertile soil and abundant nitrogen this effect may not be produced. (2) During the first three or four weeks of the plant's life the prussic acid is concentrated in the stalks. Then it rapidly decreases and disappears there, but apparently persists in the leaves in decreasing percentages until maturity. (3) Climate and variety may be more important factors than soil nitrogen in determining the amount of the acid in the plant. (4) Complete hydrolysis of the glucoside is obtained by digesting the macerated tissue for two hours at 40° to 45° C. The paper on which these conclusions are based will be found in the JOURNAL OF AGRICULTURAL RESEARCH for May, 1915.—THE AGRICULTURAL NEWS.

NOTES.

THE PLANTERS' CHRONICLE draws attention to the importance of *Apis dorsata* (the Ceylon Bambara bee) in the pollination of coffee in south India. In view of the fact that considerable numbers of this bee are destroyed by natives, it has been suggested that estate managers should communicate with the Forest Department with a view to putting a stop to interference with this insect.

The common honey bee (*A. indica*) is not less active wherever fruit trees are under cultivation, and its value for pollination purposes is a matter which is not sufficiently appreciated. As it is capable of domestication (unlike *A. dorsata*) and besides yields a palatable honey, those who have to do with fruit crops would do well to keep as many hives of this bee as possible.

THE KEW BULLETIN records the death on May 31st last of SIR ARTHUR CHURCH. An acknowledged authority on the chemistry of pigments and minerals, PROF. CHURCH will be best remembered as an agricultural chemist. There are no doubt some who can recall him as lecturer on Chemistry at the Royal Agricultural College, Cirencester, while his LABORATORY GUIDE is a familiar text-book. In the Eastern tropics his classical work on THE FOOD GRAINS OF INDIA is a well-known work of reference.

The lack of female flowers in Cucurbits is most frequently to be attributed to the plants making too rapid growth and failing to produce lateral fruiting shoots. The remedy recommended is to pinch off the growing points and stop the laterals developing. Keep the plants dry and pick off the bulk of the male flowers.

The JOURNAL OF THE ROYAL SOCIETY draws attention to the virtues of cod-liver oil as an insecticide, and states that it has been found an effective remedy in New Caledonia against horse-flies which infect sores and wounds, the flies being killed immediately by contact with the oil. It is also claimed that cod-liver oil is equally efficacious against the house fly and mosquito as well as against ticks in dogs and other animals.

A note in the AGRICULTURAL NEWS gives an idea of the enormous trade in tomatoes in Italy. It is estimated that there are about 385,000 acres under the crop. The annual export to the United States is about 20 million pounds, while some 8 million pounds go to S. America. The total value of tomato exports from Italy are said to be well over 6 million dollars. With this enormous output it is only natural that some use has been discovered for what has hitherto been considered waste material, i.e. the skin and seed. The former is now being used for cattle feed and the latter for oil production, the refined oil being edible, while the crude oil is used for soap-making and burning.

GENERAL.

SCHOOL GARDENS.

While originally the school garden scheme only applied to Government Vernacular Schools, it is now open to any grant-in-aid school to become registered, so that, if inspected and found eligible, it may secure a grant. This grant may be either Rs. 50 for gardens of not less than an acre, or Rs. 30 for those not less than a third of an acre.

In the case of Government schools a vote is provided for making awards, and the amount available is utilised to the best advantage by the Superintendent of School Gardens. Ordinarily, there are three classes of prizes, viz., Rs. 30, Rs. 20, and Rs. 10, which are awarded according to the merits of the gardens. In considering these merits the previous record of the garden, and not merely the show it makes when inspected for awarding prizes, is taken into consideration.

While Government Schools are furnished with fences and implements, aided schools have to look to their own Managers to provide them with all garden requisites. It is unfortunately often the case that Managers fail in this obligation, and teachers are expected to carry on their work the best way they can. This is, of course, very hard on teachers and boys, and is not calculated to encourage them in developing their gardens.

Another matter which it would be well to refer to here is, that while the awards made by Government reach the teacher and his boys (half going to the teacher and half divided among the best workers), the grant to aided schools often goes to swell the common school fund and does not find its way to the schoolmaster or his scholars.

There are, however, a number of excellent aided school gardens in the Island, and the illustration appearing as frontispiece shows the garden attached to the Walana Buddhist school near Panadura, the teacher in charge of which has done continuously good work. Though provided with only a very limited piece of land he has made the very most of his opportunities and displayed great taste in the laying out of the garden, and what is of chief importance, he has trained his boys to take an intelligent interest in their outdoor work and in the study of plant life.

C. D.

BRITISH GUIANA BALATA.

PROFESSOR HARRISON.

The trees from which balata is obtained are found growing all over the colony, particularly on the lower but not swampy lands along the banks of the smaller rivers and creeks. They are, perhaps, most abundant in the county of Berbice, where the balata-collecting industry has been established for the past five years.

The collection of balata is carried out under licences issued by Government. For the purpose of the administration of balata collection the colony is divided into sections of 50 or 250 square miles in area, the former in the more readily accessible and the latter in the less readily accessible parts of

the colony. A separate licence is issued for each section, and confers the right to collect wild rubber as well as balata. The terms are for not more than fifteen years, an application fee of £1 13*s.* 4*d.* and an annual rental of £4 3*s.* 4*d.* for each licence, and a royalty of 1*d.* per lb. on all balata and wild rubber collected. The licences are issued for collecting only, and may be cancelled if the land is required for agricultural or mining purposes. The collection is carried out by negroes and aboriginal Indians, who are registered as bleeders. No tree is allowed to be bled which does not measure 36 in. in girth and 4 ft. from the base. Trees may be bled on one-half of the circumference only at any one time. No tree is allowed to be re-bled until five years have elapsed from the previous bleeding. The cuts employed for extracting the milk must be not more than 1½ in. wide and not closer together than 10 in.

The collectors proceed to the grants from January to April, and the work generally commences towards the end of May and extends to the beginning of October. The collectors are paid by the weight of balata obtained.

Bleeding is done by means of a cutlass ; the incisions are 10 in. apart, and are arranged in a feather-stitch pattern. Bleeding is commenced at the base of the tree, and extends to the main fork ; the branches of trees are seldom bled. The milk is collected in a calabash (made from the fruit of *Crescentia cujete*), placed at the bottom of the tree, and held fast by inserting its lip between the bark and wood of the tree. The first bleeding is done while the collector is standing on the ground ; the parts of the trunk situated higher up are bled by the aid of a ladder roughly constructed in the forest, while the highest parts are frequently reached by the aid of a rope for climbing.

The latex is transferred from the calabashes to kerosene tins and taken to the camp, where it is poured into a shallow tray (dabree) and allowed to evaporate. This tray is constructed generally of pieces split from the stem of a palm. The latex coagulates by evaporation, and the balata is removed in successive sheets from the top to the bottom.

The yield varies up to certain limits according to the age and size of the tree. Speaking generally, 5 lb. of dry balata per tree is considered a good yield.

Recent investigations have shown that the yields obtained by bleeding standing trees with cuts arranged in the feather-stitch pattern are not less than those obtained by first felling the trees and then extracting as much latex as possible by completely ringing the bark, and this fact has prevented the ruthless destruction of the tree, which is valuable for its timber as well as for its production of balata.

The following table shows the export of balata in five-year periods since 1893 :—

Period.		Total lb.
1893-7	...	1,133,123
1898-1902	...	2,009,785
1903-7	...	2,488,951
1908-12	...	5,376,059

The exports go chiefly to the United Kingdom, the remainder going to the United States of America and to Holland.

The export of balata from the colony for the year 1913 was 1,323,609 lb. of the value of £160,000. Owing to the war closing some of the important European markets the export for 1914 fell to 1,022,750 lb.

As the balata tree occurs in large quantity in the forests of the colony, and providing the product continues to realise its present market value, there is a prospect of the balata industry continuing to flourish for many years to come.—BULLETIN OF THE IMPERIAL INSTITUTE.

THE VALUE OF TRENCHING.

VICARY GIBBS.

I have recently been reading a very interesting paper in the July number of the JOURNAL OF FORESTRY "on the harmful effects of certain grasses and weeds around the roots of young forest trees." I heartily commend its perusal to readers, and especially to those, if there be any, who are not already convinced of the advantage which young trees gain from being in open ground as against those which stand on turf.

The paper gives details of some experiments which were carried out at Ryston in 1912. Fourteen plots were laid out, 7 feet long by 3 feet wide, and on each of them were planted three common Ash and two Larch. Two plots were kept clear of all other growth; one was sown with Stinging Nettle, one with Creeping Buttercup, and the remaining ten plots with various kinds of Grasses such as are commonly found in young plantations.

The result was as follows, taking 100 as the percentage of growth in the two clean plots. The least harmful of the ground coverings proved to be the Creeping Buttercup, where, however, the percentage of growth of trees was only 52, or little more than half that in the clean ground. The next was the Stinging Nettle, where the percentage was 41. In the case of plots covered with various Grasses the percentage ranged from 33 to 13, the covering of the ground which proved most detrimental to tree growth being Cooch Grass and perennial Rye Grass, in which two cases the rate of tree growth was but 15 and 13 per cent., respectively. There appears to have been but little difference in the effect of various crops on the Ashes as distinguished from the Larches. A photograph of the Ashes and their foliage, which accompanied the paper, brought out very markedly the difference not only in height of the trees growing on clean ground, but in the colour, size, and appearance of the foliage.

Reading this paper, of which I have given a short and imperfect account, has tempted me to set out the results of a somewhat similar experiment which I have made (unintentionally) at Aldenham of the different rate of the growth of trees of the same kind when planted in trenched and untrenched ground. Some eighteen years ago I planted a row of fourteen Maples (Acer Schwedleri). Twelve of them stand on lawn, being planted in holes 6 feet across, which are kept clean and free from turf and weeds. At the time of planting the clay was removed and the holes filled with good light loam. The thirteenth stands half on lawn and half in a shrubbery where the ground was well trenched; the fourteenth stands wholly in trenched ground.

About the same time, perhaps a year later, I planted fourteen Copper Beeches, and in this case too, the conditions are the same, twelve trees being in a field, the thirteenth on the edge of a trenched plantation, and the fourteenth growing wholly in the plantation. About the year 1875, my late father planted a double avenue of Horse Chestnuts along the drive in the park. The holes made were not large and there was no breaking up of the adjoining ground, consequently though the trees are healthy the growth has been very slow. Some eighteen years ago it was decided to put a new bridge over the lake at the end of the Chestnut avenue, and this necessitated a gradual raising of the drive as it approached the bridge, and the consequent lifting and replanting of the first trees in the loose, newly-raised ground at the sides of the road. Although it might have been expected that moving fairly big trees aged about twenty-four years would have checked their growth and thrown them behind their unmoved brethren, yet so great has been the advantage to them of growing in what is equivalent to well trenched ground, that it has much more than compensated them for the check of moving, and now after eighteen years they are bigger, taller, with wider spread, more vigorous and darker foliage, and in every respect finer than the unmoved ones.

I will now set out in tabular form the results in all three cases of planting in trenched and untrenched ground, and I hope it will convince any intending planters who read these lines that, at any rate on heavy clay land like ours, the labour and cost of trenching is not only thrown away but is absolutely essential to successful planting. Many years ago when I had less experience than I have now, I tried making small plantations without trenching, as I grudged the labour and expense. The attempt resulted in total failure. After wasting ten to fifteen years I had to have the ground trenched after all, and young trees planted in between the others, and these have already passed those which had a long start of them. I can say broadly that on this heavy London clay all trees benefit enormously by trenching, and as for even the hardiest Conifers, they will not grow at all without it, for when their roots reach the walls of the hole they fail to penetrate, and the trees become holebound.

Trenched Ground.

	Height. Ft. in.	Circumference of branches. ft.	Girth 3 ft. 6 in. high. in.
Maple ...	26·6	60	25
Copper Beech	31·0	57	28
Horse Chestnut	40·0	106	51

Partly in Trenched Ground.

Maple ...	23·0	57	18
Copper Beech	27·3	42	18½

Untrenched Ground.

Maple ...	19·0	42	13½
Copper Beech	19·9	36	12
Horse Chestnut	34·0	75	34

There is one other matter which I should like to mention before concluding my remarks. Although the deleterious effect of grass and weeds on young trees, referred to in the earlier part of this article, is generally recognised, yet the expense of weeding is so prohibitive that it is usually abandoned the moment that the trees are high enough not to be choked by the grasses. Yet, if people would only realise it, it is possible to take most satisfactory crops of vegetables, such as Potatoes, Cabbages, Kale, Savoys, Broccoli, and Turnips, off ground where the young trees are eight to ten years old, and range from fifteen to twenty feet in height. I should like to show any readers of the GARDENERS' CHRONICLE the young covert at Aldenham, where every available inch of ground is cultivated, and has been cultivated, with profitable vegetable crops ever since the trees were planted. Of course, in time of war and high prices, such as we are living in now, a very good profit can be made out of vegetables from land which would otherwise lie idle, but the same crop was taken two or three years ago when the German peril was scoffed at by the majority, and when the primary object of such planting was to make the crop pay for the cost of weeding. Certainly the result has been to produce an abnormally rapid and satisfactory growth in the mixed timber, with which the young wood is planted, and which consist for the most part of Ash, Oak, Norway Maple, Hornbeam Elm, Cherry, Birch, and Lime. Some parts which have only been planted three or four years have all the appearance of five to six years' growth. I should add that the land has not only been well trenched, but well drained with open ditches, otherwise the results would have been very different.—THE GARDENERS' CHRONICLE.

VILLAGE WAR FOOD SOCIETIES.

It is probable that the most successful means of increasing the production of all classes of foodstuffs, other than those which can only be produced on small or large holdings, would be the formation of what might be termed "Village War Food Societies." This title is suggested as useful, without reference to "cultivation," because it will cover the *utilisation* and *consumption* of foods as well as their production.

Such societies might often be amalgamated (at any rate for the period of the war) with the local gardening and allotment societies, and they might in some cases cover a group of villages. Even where there are allotments the workers can commonly cultivate much more land than they have, and the necessity and desirability of producing more food of all kinds should be impressed upon each village as a unit. The interest of the women and children should be especially enlisted, as their aid will be of very great importance to the success of any operations undertaken.

Formation.—The formation of a society might be brought about by the Clerk to the Parish Council, who might call a meeting of local residents interested in gardening, pigs, poultry, bees, etc., for the purpose of considering the question of the formation of a local society. This being decided upon, a small committee should be elected (with chairman, secretary, and treasurer of the society) to organise the work of the society on a business footing.

Objects.—The object of each society would be to ascertain the position of vacant building plots, uncultivated "waste" areas, and even some common land; discover the owners and secure permission to cultivate such land (if possible, without charge to the society); arrange either for co-operative and mutual cultivation of the land so secured, and ownership of the produce, or parcel it out to the members to cultivate for themselves individually; secure manures, seeds, plants, stock, foodstuffs, and implements on a co-operative basis, and sell or preserve for home use the produce of their labours.

Again, leaflets on the growing of vegetables and fruit, pig-keeping, poultry-keeping, rabbit-keeping, bee-keeping, the bottling and preserving of fruit, storage of vegetables, preservation of eggs, etc., can be obtained free of charge and post free on application to the Board of Agriculture and Fisheries. Further, there are in most districts capable gardeners and breeders of small stock (pigs, rabbits, poultry, and bees), both professional and amateur, who would be glad to give the benefit of their experience to persons who require help in this way.

Rules.—A short, concise set of simple and plain rules should be drafted, based on whether the cultivation of the plots is to be individual or co-operative as regards produce. If the work were to be co-operative and mutual all through, the produce would be divided in proportion to the labour and interest of the individual or be pooled and shared equally by the members. Again, actual cultivation might be individual, but seeds, stock, etc., might still be supplied on a co-operative basis. In any case the members would have to subscribe a small sum to get the society started and place it on a secure footing.

Poultry.—Every additional egg and every extra chicken reared will help the food supply, if produced under proper conditions; and there is at the present time special need to increase the numbers of both eggs and poultry. Any reduction in the laying or breeding stock of poultry kept is against the best interests of both the individual and the nation, and each society should do all it can to extend poultry-keeping in its district—again,

either by individuals or collectively by co-operation. The number of persons who could readily keep poultry is very great, and a few birds kept by each would not only enable them to utilise much household and garden "waste," but to utilise it in the economic production of eggs and table birds, and add to the resources of the country.

Preservation of Eggs.—While it may often be desirable and profitable to sell the eggs produced when new-laid, the societies may usefully consider whether their numbers cannot act in concert, purchase jars and materials in bulk, and preserve eggs for future use. By this means it may be possible for a small district or village to put by some thousands of eggs during the "cheap" season for use when eggs are dear, and so save the meat bill. The more useful means by which eggs may be preserved are described in Leaflet No. 83 (*Preservation of Eggs*).—JOURNAL OF THE BOARD OF AGRICULTURE.

NOTES ON THE MAKING OF CONCRETE.

C. W. FOSTER.

Owing to the price of timber having advanced considerably during the last few years, and also to the difficulty in obtaining sound and seasoned material, concrete is gradually taking its place in many instances on the farm as elsewhere. Concrete has certainly the advantage over wood so far as durability is concerned, and in many cases, especially when good clean gravel can be obtained on the farm, it has the advantage in cost and transit. However, there is good and bad concrete, and care must be taken in the selection of the materials used, and also in the mixing, if good results are wanted.

Ideal concrete is made from a mixture of broken rock, or clean, screened gravel varying in size from stones that will pass through rings from half an inch to two and a half inches in diameter, depending on the nature of the work, clean coarse sand, and first-class cement, in such proportion that the voids between the stones will be filled with sand, and the voids between the grains of sand filled with cement, with the cement slightly in excess of the quantity necessary to fill the sand voids, in order to furnish additional adhesive properties to thoroughly combine the sand with the broken stone. In large mass work the broken stone, or aggregate, as it is generally called, may be used in much larger sizes. However, in reinforced concrete work the aggregate should be smaller—from one half to one inch in diameter.

The greatest care should be exercised in the selection of the aggregate, because the power of adhesion of a high grade cement to stone is shown by the fact that when a piece of concrete, several months old, is broken, the line of fracture usually runs through the stone; therefore we may take it that the ultimate strength of concrete depends largely upon the character of the aggregate. Usually the character of the aggregate depends upon the availability of the supply, but where there is much choice in the selection, those which are hardest and which break with a cubical fracture will make the best concrete, although some engineers prefer rounded pebbles because they are more easily handled. Avoid soft sandstone, soft limestone, shale, or any soft rock. Granite, hard limestone, or gravel are best.

For ordinary construction, gravel is more generally used than any other aggregate, and in places it is found mixed with sand in nearly correct proportions. The stones in the gravel must be clean, as a coating of clay or soil will prevent the cement from adhering to them.

The sand used should be clean and coarse, that is, it should be free from clay or soil, as both the latter retard the setting of cement and, if present in large quantities, destroy its adhesive property. Three simple ways of telling whether sand is clean or not are as follows :—

1. Rub some between the hands, and if they are badly discoloured do not use it.

2. Drop a handful into a bucket of water, and if the water is clear enough to see the sand at the bottom in a minute it is "clean sand."

3. Fill a bottle or glass jar one-quarter full of sand, and add clean water until the bottle or jar is three-quarters full. Shake well, and if a layer of mud settles over the sand, do not use it.

Of course, if the soil be removed by washing, the sand may be used.

The sand should be sharp as well as clean, with the main proportion of the grains from 1/32 of an inch to 1/16 of an inch in diameter, and even if a few are somewhat larger there is no objection to them. Sand with very fine grains, even if clean, makes a poor mortar or concrete, and if its use is unavoidable, an additional quantity of cement must be used to thoroughly coat the grains. It is most important that good quality cement be used, as otherwise the ultimate strength of the concrete cannot be depended upon. Great care should be exercised in storing cement prior to using it, for should it become at all damp it will cake and harden, and its usefulness will be greatly impaired. It is wise to obtain only sufficient quantity for the work in hand, and get fresh supplies when more concrete work is to be done. It will pay best in the long run to use only the finest quality of cement obtainable.

The proportion of cement, sand, and aggregate depend upon the class of work to be done, and also upon the size of the stones forming the aggregate. When the size of the stone is such that it will pass through a two and a half inch ring but will not pass through a two inch ring the concrete is weaker and requires more cement than one made with graded stone from $2\frac{1}{2}$ inches downwards. When the stone is graded in size, the stones of smaller size fill the voids between the larger stones, and thus reduce the quantity of cement and sand required.

In estimating, do not make the mistake, so often made by the uninitiated, of thinking that six cubic yards of broken stone, three cubic yards of sand and one of cement will make ten cubic yards of concrete. As previously stated, the sand fills the voids between the stones, while the cement fills the voids between the grains of sand ; therefore the total quantity of concrete will be but slightly in excess of the original quantity of broken stone. The strongest concrete does not always have to be used, as it may be required to withstand only slight stresses, and be used simply for its weight. The strongest concrete would then be unnecessarily expensive.

A common proportion for unimportant works is 1—3—6, or in other words, one part cement, three parts sand, and six parts broken stone or gravel. This proportion may be used for foundations below ground, retaining walls, foundations for asphalt pavements, and for similar purposes. For ordinary machine foundations, thin foundation walls, walls of buildings, paths, floors, etc., a mixture in the proportion of $1—2\frac{1}{2}—5$ is suitable. For reinforced engine or machine foundations, tanks or other water-tight work, a richer mixture in the proportion of about 1—2—4, or stronger, is required.

In measuring out the quantities of material, a wooden frame is usually used, made like a box with the top and bottom removed, and handles attached. This is made of a convenient size, depending on the size of the work and on the quantity of material that can be handled at one time. Mixing should be done on a smooth, flat, water-tight platform, in the following manner :—Measure the sand and spread it in an even layer on the board,

Place the cement on top and turn with a shovel at least three times, or until the two are thoroughly mixed, as shown by the uniform colour. The aggregate, being previously made thoroughly wet, should then be placed on the top, and the mixture again well turned three times, water being slowly added, and in small quantities at a time, during the second turning. The quantity of water depends upon the nature of the work, but generally speaking sufficient water should be used to give a "mushy" mixture, just too soft to bear the weight of a man when in place.

Buckets are most convenient for measuring the water, and enough bucketsful should be provided in advance for wetting an entire batch. If a hose be used it should be provided with a sprinkling nozzle, or otherwise much of the cement is liable to be washed out of the mixture. The water used should be clean and free from acids or strong alkalis. Care should also be taken that no water flows off the mixing board, as it is liable to carry some of the cement with it.

Concrete should be mixed as near to the place where it is to be used as practicable, so as to avoid delay in getting it into place. Greater quantities should not be mixed than can be conveniently placed within a reasonable time, otherwise if left standing any length of time, it will set and become useless. Should the cement begin to harden before being placed in the form, so that it lumps when re-tempered, it is best to discard, as the hardening qualities of cement are affected if disturbed after it has begun to set.

We find then, in conclusion, that although two lots of concrete may be made in the same proportions, their strengths may vary considerably, owing to the material used for the aggregate, the presence of soil or clay in the sand or stone, insufficient and uneven mixing, or in using cement that has been exposed to the weather or stored in a moist place and become perished.

An example of the use of concrete on the College Farm consists of fencing posts. Ordinary fencing posts are made 6 ft. 6 in. in length, 5 in. wide at the bottom and 3 in. at the top, and have a depth of 5 in. Either holes for the wires are made in the concrete when in the moulds, or staples are set in the side. The moulds, of course, can be used over and over again. These posts were reinforced with ordinary galvanised plain wire placed from 1 in. to 2 in. in from the surface, being bent at right angles at each end to prevent it slipping. The cost of these posts will, of course, vary in different localities, depending mainly on whether the aggregate can be obtained on the farm or not. A very liberal estimate is 1*s.* a post, but should be made for less on most farms. After being turned out of the moulds the posts should be allowed to stand from three to six months before being used.

Straining posts and those used for hanging small gates are made 8 in. square, 7 ft. in length, reinforced with $\frac{1}{4}$ in. mild steel bars. The hangers for the gate can of course be put in whilst the post is being moulded. The reinforcing costs 1*s.* a post, and the concrete about 2*s.* 6*d.* For heavy gates and to give a better appearance to the post, one 12 in. square, and 5 ft. above the base may be built *in situ* with special moulds. A sixteen inch square hole should be dug 2 feet deep. This is filled with concrete and the mould set on top and stayed in position. The mould can be held together with straps so that when the latter are removed it comes to pieces. The reinforcing, which goes into the base, consists of $\frac{3}{8}$ in. mild steel bars, four in each post, and 2 in. from the corners. These latter should be laced with wire to keep them in position when the concrete is being placed, and the ends bent to prevent slipping. The cost of each post is approximately 9*s.* 6*d.*—CANTERBURY AGRIC. COLLEGE MAGAZINE.

COMPARISON OF TILLAGE AND SOD MULCH.

U. P. HEDRICK.

A continuation of the studies at the New York Agricultural Experiment Station to determine whether the apple thrives better under tillage or in sod. The experiment summarised in this paper was begun in 1903 in an orchard of Baldwin trees. The tilled land was ploughed each spring and cultivated from four to seven times. The grass in the sod plot was usually cut once, sometimes twice, all other operations being identical for all the plots.

The experiment was divided into two 5-year periods. During the first period the orchard was divided in halves by a north and south line, and during the second period by an east and west line. Thus, one quarter of the orchard was under tillage 10 years; another under tillage 5 years, then left in sod 5 years; the third quarter was in sod 10 years and the fourth in sod 5 years, then tilled 5 years.

The writer summarises the results as follows:—

The average yield of the plot left in sod for ten years was 69·16 barrels per acre, that of the plot tilled 10 years 116·8 barrels per acre, making a difference in favour of tillage of 47·64 barrels per acre per annum. The fruit from the sod plots was more highly coloured than that from the tilled land and matured from one to three weeks earlier than the tilled fruit. The latter keeps from two to four weeks longer than the former and is also better in quality, being crisper, juicier and of better flavour. The uniformity of the trees under tillage was in striking contrast to that of the trees in sod, which lacked uniformity in every organ and function of which note could be taken. The grass had also a decided effect on the wood of the trees, as evinced by the greater number of dead branches and the less plump and duller appearance of the sodded trees. The leaves of the tilled trees came out three or four days earlier and remained on the trees several days longer than on the sodded trees. Those on the tilled trees were a darker, richer green and more numerous, indicating greater vigour.

The effects of the change from sod to tillage were almost instantaneous. Both tree and foliage were favourably affected before midsummer of the first year, and the crop, while below normal, consisted of apples as large in size as any in the orchard, the falling-off in yield being due to poor setting. The change from tillage to sod was quite as remarkable and as immediate, the average yield of the new sod plots being less than half that of the tilled plots. The use of nitrate of soda in the sod plots greatly increased the vigour of the trees and was a paying investment, yet for the 5-year period the yield was only slightly more than half as much as that of the tilled trees.

The very marked beneficial effect on sodded trees of placing adjacent ground under tillage shows that the sod should not only be removed round the trees but also for a considerable distance from them.

The changes in the soil due to the two systems concern chiefly the amount of humus and nitrogen. It was found that tillage and cover crops conserve humus and nitrogen better than the sod-mulch treatment.

The pasturing of pigs, sheep or cattle on sodded orchards does not overcome the bad effects of the grass.

The average cost per acre of growing and harvesting apples in sod was $57·73 and under tillage $83·48, making a difference of $31·75. Subtracting these figures from the gross return leaves a balance of $74·31 for the sodded plots and $140·67 for the tilled plots, or an increase of $66·36 in favour of tillage.—BULL. INT. INST. OF AGRIC.

MADRAS AGRICULTURAL RESEARCH.

SUGARCANE.

Varieties and cultural methods.—This section deals only with the work on the district farms. DR. BARBER's work is dealt with separately, whilst the missionary work in the districts falls under the heading of Demonstration, etc. It was due to the presence of the red-rot disease in Godavari that the first district farm was ever started, viz., at Samalkota. The great achievement there was the discovery of a cane very much more immune to this disease than the local variety, viz., Red Mauritius. But even so there is still some red-rot about. The last three years' work at Samalkota has clearly shown that the loss from this disease may be entirely prevented by the exercise of a little care. There the practice is to harvest the canes clump by clump and tie together all those from one clump. As the canes are cut they are carefully looked over and any setts cracked or bored or with broken buds are discarded, and if there is any sign of disease in any cane from a clump no setts whatever are taken from the canes of that clump for planting next year. The results have been as follows: out of 18,000 clumps which were grown in 1912-13 only 70 subsequently showed any traces of disease, in 1913-14 out of 38,500 clumps only 838 and in 1914-15 out of 32,200 only 175 or taking the three years together the incidence of the disease is only $1\frac{1}{4}$ per cent—a very different state of affairs from the time when the area under sugarcane in Godavari was rapidly decreasing because the majority of the clumps were so badly diseased that the cultivation of cane more often resulted in loss than gain. Among the varieties tested at Samalkota B. 3412 for the second year in succession topped the list in yield of raw sugar per acre with $8\frac{1}{3}$ tons. Java, 247, again came second. On the average of the last three years the positions of these two are reversed, but if B. 3412 maintains its position this year it will be put out in the district. For the conditions in Vizagapatam on the other hand B. 1529 appears to be suitable—a cane which is steadily improving its relative position at Samalkota but as yet has only reached fourth place there. Much reliance, however, cannot be placed upon the Anakapalle results this year as the farm was first flooded and later many of the canes were laid low by a cyclone. At Nellikuppam MESSRS. PARRY & CO. are testing most of our varieties of cane on field scale and under factory conditions. These results are not yet to hand.

Sugarcane is one of the most paying of crops and requires intensive cultivation. Questions therefore connected with its manuring are of importance. A series of experiments tried some time ago showed that on the delta land of Samalkota artificials were not so profitable as oilcakes, and for the last three years different oilcakes, viz., safflower, pungam, gingelly, groundnut and castor have been tried against each other. So far as any inference can be drawn from these results as yet it would appear that none of these possesses any peculiar virtue over its competitors; the controlling factor in the nett profits is the price at which these cakes can be obtained at the time of purchase provided about 120 lb. of nitrogen is given per acre. There is, if anything, a slight advantage in gingelly cake unless the price rises very high.

PEPPER.

The year on the West Coast was altogether peculiar. There was practically a seven months' drought from October 1913 to May 1914 as only 1·56" of rain were received instead of the average 8·35". The result was that many of the vines died and all, except those in the most sheltered corners, suffered from lack of shade in the hot weather. On the other hand there was almost an entire absence of the usual disease "pollu," and the final result on the whole was a record yield of pepper from the farm, viz., 4,741 Madras

measures of green pepper (practically 4,741 lb. of dry pepper); but the yields varied so much according as to the amount of shade received in May that for the comparative purposes the results from the different plots are of little value. Of the varieties Kallavalli continued to improve its position as the heaviest yielder.—REPORT OF THE MADRAS AGRIC. DEPT., 1914-15.

THE PALMYRA PALM AS A SOURCE OF SUGAR.

M. N. GHOSH.

The juice of the Palmyra palm is collected twice a day, in the morning and evening; but owing to fermentation the juice collected in the evening is not suitable for the production of sugar. This trouble may be prevented by coating the inside of the collecting cups with lime, or washing them with formalin. Smoking the pots after cleaning also acts as a preventive of fermentation, but the best results are obtained with formalin.

Five or six pots may be hung on a full grown tree during the flowering season and a total of from 12 to 15 lb. of juice obtained. The juice contains about 12 per cent. of saccharose and is remarkably free from glucose (non-crystallisable sugar). The yield of gur, or crude sugar, is about 1½ to 2 lb. per tree per day, or 200 lb. per annum.

At present the tree is seldom cultivated, but is planted along the boundaries of plots of land. As suggested by ANNETT, it is very probable that in places where it is grown side by side with the date palm (*Phœnix sylvestris*) which produces its sugar during the cold season, a sugar factory would be able to work with profit throughout the year.—BULLETIN INT. INST. OF AGRIC.

AMERICAN RICE TRADE.

A recent American Consular report says there has been increased American commercial activity in rice during the past three years. The imports of rice averaged about £400,000 and of rice flour, meal, and broken rice about £450,000 annually during the five fiscal years 1906-1910. Production and prices of rice in the United States have fluctuated greatly, having been 21,096,000 bushels, valued at 65·8 cents. (about Rs. 2) per bushel in 1904. and 12,933,000 bushels, valued at 95 cents (about Rs. 3) per bushel in 1905. Production from 1908 has always exceeded 20,000,000 bushels, and in both 1912 and 1913 went over 25,000,000 bushels. In 1914, however, the American crop dropped to 23,649,000 bushels. The Carolinas, once the leaders in rice growing, have been turning to other crops, while Texas, Louisiana, and Arkansas, have been planting much larger areas—813,200 acres in 1913 out of a total for the country of 827,100 acres. The most noted recent increase has been in California, which started rice-growing in 1913, when 293,000 bushels were grown. In 1914 California produced 800,000 bushels; the acreage increased from 6,100 acres to 16,000 acres, and the 1915 planting will probably exceed this. It is estimated that 200,000 acres may finally be devoted to rice in California, this being the area suitable to its culture. If this should be accomplished, rice production of the United States should go up to nearly 35,000,000 bushels.—INDIAN AGRICULTURIST.

DESTRUCTION OF FLY LARVÆ IN HORSE MANURE.

MESSRS. COOK, HUTCHINSON and SCALES have issued, through the U. S. Department of Agriculture, a further bulletin (No. 245) of their experiments in the use of divers substances in destroying the larvæ of flies. Our readers will remember that in their earlier report BULLETIN No. 118, U. S. Department of Agriculture) they recommended for this purpose the use of borax applied at the rate of ·62 lb. per 8 bushels or 10 cubic feet of manure. Although it is claimed that manure treated in this manner may be applied to the land at the rate of 15 tons to the acre without injury to vegetation, the authors recognise that there is a risk to crops if larger quantities of borax are added. They have, therefore, sought to discover other substances which, whilst not open to this objection, may be used to destroy the larvæ of flies. At the same time the authors repeat their recommendation of the use of borax for the treatment of out-houses, refuse heaps, and similar places in which flies deposit their eggs. Of various substances experimented with some, though effective, are too expensive for use on manure heaps ; but they find in powdered Hellebore (*Veratrum album* and *V. viride*) a substance harmless to plants (and also to chickens) and destructive of fly larvæ. The cost at the present price of Hellebore powder is not prohibitive : in America it is 0·69 cent. per bushel of manure ; but it is to be feared that with a general demand for this substance the price would advance. Furthermore, it is doubtful whether the present stocks of Hellebore would suffice to meet a widespread demand. It is also to be noted that Hellebore, as we know it. is the powdered root of Helleborous niger, and that this plant, which is not a commercial product in the United States, was not tested. On general grounds, however, it is probable that European Hellebore would be no less efficacious than the spurious Hellebore, *Veratrum viride* (Swamp Hellebore), on which the American experiments were made. It is, however, to be desired that experiments should be made with the powdered root of Helleborous niger. The authors recommend that the powdered Hellebore be mixed with water at the rate of one-half pound to 10 gallons, the mixture stirred, and allowed to stand in a barrel for several hours, and sprinkled on the manure heap at the rate of 10 gallons to eight bushels of manure, paying particular attention to the edges of the heap. A rough estimate of the amount to use per day may be made by reckoning that 2 bushels of manure per horse—a liberal estimate —is the daily output.—THE GARDENERS' CHRONICLE.

STIMULATION OF NITROGEN-FIXATION BY AZOTOBACTER.

H. S. REED & B. WILLIAMS.

The effects of various organic compounds on the development of Azotobacter have been injurious to plant growth which are important factors in modifying the fertility. Azotobacter was chosen to represent the microflora of the soil owing to its recognised importance in maintaining fertility and to the possibility of making accurate analytical measurements of its activity. The compounds chosen were such as are likely to occur in the soil; esculin, vanillin, daphnetin, coumarin, pyrocatechin, heliotropin, arbutin, resorcin, pyrogallol, floroglucin, hydroquinone, salicylic aldehyde, oxalic acid, quinic acid, dihydroxystearic acid, rhamnose, borneol, caffein, betain, trimethylamine, legumin, alloxan, cinnamic acid, aspartic acid, asparagin, hippuric acid, creatin, xanthin and hypoxanthin, urea, formamide, glycocol, allantoin, guanidin, nicotin, picolin, scatol, piperidin.

The results of the experiments show that the majority of the compounds studied have only a slight influence on the fixation of nitrogen by Azotobacter ; in many cases a depression was noted, but this was generally due to considerable concentration of the compound in question.

Hydroquinone and salicylic aldehyde showed greater toxicity than any other compounds. Esculin, quinic acid and borneol had a markedly stimulating action on the development of the organism.

The effects of these compounds on Azotobacter do not generally agree with the action recorded in the case of higher plants ; in concentrations fatal to certain higher plants, many of them show only a slight reduction in the fixation of nitrogen.

Some of the nitrogenous compounds investigated, as nicotin, picolin, guanidin and scatol, showed toxic properties similar to those usually attributed to them, while caffein apparently acted as a stimulant. On the other hand, many nitrogenous compounds recorded as having a beneficial action on higher plants, were found to have a depressing action on nitrogen-fixation by Azotobacter ; in this case the simpler compounds appeared to have a more energetic action than the more complex ones.

It is suggested that this is not due to toxic properties, but to the fact that the nitrogen of these bodies is used by Azotobacter in preference to atmospheric nitrogen. Urea, glycocol, formamide and allantoin gave particularly noteworthy depression of nitrogen-fixation.—BULL. INT. INST. OF AGRIC.

NEW SYSTEM OF COTTON CULTIVATION.

O. F. COOK.

The system which is here described and recommended has been successfully tested in several localities of the United States, both by the Bureau of Plant Industry of the Department of Agriculture and by practical farmers.

The way to secure an early short-season crop of cotton is to thin the plants later and leave them closer together in the rows than is now customary. Neither of these policies is advisable if used alone, but they give a real advantage when properly combined. Keeping the plants closer together during the early stages of growth restricts the formation of vegetative branches and induces an earlier development of fruiting branches.

The spacing of the plants and stages at which thinning should be done will depend upon local conditions and will have to be determined experimentally in every case.

So long as the plants are close together they do not form vegetative branches ; hence by thinning them when the stalks have grown beyond the stage in which vegetative branches are produced, the latter are controlled or suppressed. This makes it possible to leave more plants in the rows than is now customary and yet avoid injurious crowding.

The control or suppression of the vegetative branches also permits an earlier development of fruiting branches and leads to the production of an earlier crop. In regions where the period of crop production is limited either by short seasons or by the presence of the boll weevil, increased earliness is a means of securing larger yields. Hitherto no other way has been suggested whereby it is possible for the farmer to gain such direct control of the behaviour of his crop and to ensure larger yields in short seasons. The danger of weevil injury is greatest under conditions that favour the luxuriant growth of the young plants and induce the formation of large numbers of vegetative sterile branches, and it is under such conditions that the control of the formation of branches becomes most effective as a method of weevil resistance.—

BULLETIN INT. INST. OF AGRIC.

NAMES OF TROPICAL ECONOMIC PLANTS.

A writer in a recent issue of the KEW BULLETIN, referring to the death of the eminent lexicographer, SIR JAMES MURRAY, remarks that though primarily a philologist he was deeply interested in zoology, geology and botany.

In the course of a sketch of MURRAY's life which the writer gives we find some interesting references to the names of certain tropical economic plants to which we make reference below.

Coconut. More than a quarter of a century ago PROFESSOR BALYEY BALFOUR (in Ann. Bot. i. 184) called attention to the erroneous use of Cocoa-nut, instead of Coco-nut, for the fruit of *Cocos nucifera*, and referred to the help in the matter which he had obtained from DR. MURRAY, who later on discussed the subject in a letter to KEW. It is quite clear that Cocoa-nut is wrong, yet in many publications, including those of some important botanical establishments, this spelling is still used. The mistake is attributed to DR. SAMUEL JOHNSON, who, in his Dictionary, confused the Coco-nut (*Cocos nucifera*) with Cocoa (*Theobroma Cacao*), though in using the word Cocoa he showed that it came from the Spanish cacaotal, "and therefore more correctly written Cacao." JOHNSON quotes from MILLER's Gardeners' Dictionary and MURRAY says that MILLER wrote Coco nut, but this statement appears to be incorrect, as no instance of that spelling has been found in his works, but Cocoa nut occurs several times. MILLER, however, did not confuse *Cocos* and *Theobroma*, the latter of which appears under Cacao. PROFESSOR SKEAT, in his Etymological Dictionary, has "Cocoa, the cocoa-nut palm-tree," and quotes DE BARROS, Asia, for the origin of the word. It is "called coco by the Portuguese in India on account of the monkey-like face at the base of the nut, from coco, a bugbear, an ugly mask to frighten children." PROFESSOR SKEAT explains Cocoa (*Theobroma*) as a corrupt form of Cacao.

Cinchona. LINNAEUS named the genus *Cinchona* in commemoration of LADY ANA DE OSORIO, Countess of Chinchon, who is reputed to have been the first to make known to Europe the healing virtues of its bark, familiar as Peruvian Bark, the source of the quinine of commerce. This being so, several writers, including SIR CLEMENTS MARKHAM, who took so important a part in those measures which secured the introduction of the plant into India, pointed out that the name should be Chinchona, and strongly advocated the adoption of this spelling. As a lexicographer SIR JAMES MURRAY was much concerned about this, because it was not merely that the one word would have to be changed, but many derivatives, botanical and chemical, as well. To be consistent all would have to be changed and that he thought would be "a large order." Eventually the word appeared, as LINNAEUS wrote it, with a cross-reference from Chinchona.

Potato. Five columns of the Dictionary are occupied by the word Potato with its combinations and derivatives. DR. MURRAY, judging from his letters, was perplexed by the statement, appearing in accounts of the introduction of the potato into this country, that it was brought from Virginia. "It is generally assumed to have been first brought by the remnant of RALEIGH's ill-fated colonists, whom DRAKE picked up on his way home and brought back to England in 1586. . . . But the question is how these people who lived barely two years in Virginia should have found or grown there a plant belonging to the very antipodes of that part of the American continent. Moreover, there is no later mention of the plant as cultivated there, the plant there grown until about 1800 being the Sweet or Spanish Potato (Batatas), called in America the Carolina P [otato], while *Solanum tuberosum* was at first and still is largely known as Irish Potato, from being introduced by Irish settlers at Londonderry, New Hampshire, in 1719, whence its culture gradually extended into other parts of the North American colonies." GERARD cultivated

the plant in 1596, being introduced into Spain from Quitto. It spread from Spain into Italy about 1585, and two years later was grown at Mons in Hainault. It soon appeared in various continental Botanic Gardens, including Breslau, where it was found in 1590. "The plant may have been brought independently to England. . . . but no contemporary statement associating RALEIGH's name with the potato has been found.

Tobacco. An exhaustive treatment of the words Tea and Tobacco would, as may be supposed, entail an enormous amount of research, and of this the columns of the Dictionary bear ample evidence. An enquiry addressed to KEW with regard to the latter was: "Whether there is any connection between tobacco and the name of the Island Tobago?" The Dictionary states that "COLUMBUS gave this island the appellation of Tobago, from a whimsical notion that its form resembled that of a tubical instrument, so called by the aborigines, with which they inhaled the fumes of tobacco."

CINCHONA.

The fifty-third annual report of the Government cinchona plantations and factory in Bengal for the year 1914-15 is a remarkably interesting document, and affords striking evidence of the valuable work unobtrusively carried on by the distinguished botanists who have held the post of superintendent of cinchona cultivation in Bengal. Between 1887 and 1892 enough bark was produced in the plantation at Mungpoo to meet the annual demand, never exceeding 4,000 lb., for quinine. By 1905 the demand had risen to 15,000 lb., but the annual yield from plantation bark never reached 9,000 lb. of quinine. A new plantation was started at Munsong, the old one improved, the factories enlarged, and a quinologist appointed, with the result that now the annual output of quinine has increased to as much as 50,000 lb. Not only has the quality of the trees planted been greatly improved and the area under cultivation enlarged, but the methods of extraction now employed have raised the average quinine percentage from 2·5 to 4·5. Since 1905 the annual possible harvest has increased from about 300,000 lb. of 2·5 per cent. bark to 1,000,000 lb. of 4·5 per cent. bark, a quantity assured for many years to come: the possible annual output of the factory has increased from 14,000 lb. to more than 50,000 lb. of quinine, its extraction efficiency has been raised from not more than 75 per cent. to 95 per cent. of the possible, while the manufacturing cost of quinine has been reduced from Rs. 9 to a little more than Rs. 5 per lb. Moreover, the quinine reserve has risen from less than 3,500 lb. to more than 163,000 lb. When it is remembered that cinchona takes ten years to arrive at maturity, this record of ten years' work must be regarded as a remarkable achievement. The work of reconstruction initiated by SIR DAVID PRAIN has been most ably carried on by MAJOR GAGE, his successor in office, who records his indebtedness to MR. SHAW, the Government quinologist, and to the managers of the two plantations, MR. H. F. GREEN and MR. P. T. RUSSELL, through whose keen interest and cordial co-operation the success of the undertaking has been rendered possible.—NATURE.

DRY ZONE FARMING AND THE CONSERVATION OF MOISTURE IN THE TROPICS.*

H. HAMEL SMITH.

Tropical planters must, if they wish to minimize this loss through drought, study dry-farming or moisture-conserving methods in order to utilize them on their estates. These methods include mulching, cross-ploughing, rotation of crops, wind-breaks, reforestation, subsoiling by means

* Being the paper contributed by the Editor of TROPICAL LIFE to the Eighth International Dry Farming Congress, held at Tulsa, U. S. A., in 1913.

of explosives, and the use of moisture-attracting fertilizers, as nitrate of soda beneath the surface with a mulch to cover it, so that no waste shall occur. This will encourage the roots of the trees or plants to remain down in the cool away from the *heat* and drought, and in the midst of whatever moisture there is, restricted though it may be, instead of coming to the surface to be exposed and starved, and often stumbled over and broken as it gets left projecting through the ground as the wind blows the loose soil, now turned into dust, away over land and down the hills. Thanks to the dry-farming methods above mentioned, however, the surface soil can be kept cool and retained in its place by means of a mulch, even if only a dust mulch that remains stationary on account of the cultivation it receives; and many a cacao estate during the past few years would have increased their output and benefited their trees had they adopted one or more of such moisture-conserving schemes.

Like a good many others, I shall probably use the term 'dry-farming' in a somewhat haphazard and not always, perhaps, a very correct fashion. I do so, however, for brevity, and would excuse myself for this by various sentences in DR. WIDTSOE'S well-known book,* as, for instance, on the statement that (p. 95) 'the fundamental operations of dry-farming include a soil treatment which enables the largest possible proportion of the annual precipitation to be stored in the soil.' This is exactly what many of my cacao-planting friends in the Tropics need to remember, so that they may be able to lay up a store of moisture whilst it is still there, for a 'rainless' day when it is absent. I have preached on this on many occasions in my Journal (TROPICAL LIFE) and in my books, where I report on how reliable experts have urged, and are urging, members of the various agricultural societies and others to adopt mulching by means of leaves, cover crops, or even by cultivating the surface so as to 'break' that capillary attraction in the soil which brings the moisture to the surface and causes it to be lost; this is prevented by the cultivation which utilizes the earth by turning it into a dust mulch. By such means that most-to-be-dreaded result of drought, viz., cracking of the soil (a serious matter that can lead to the death of the trees), can at least be avoided, and the water beneath the surface conserved and kept below to be diverted to, and almost entirely taken up by, the rootlets of the trees, cacao, rubber, coco-nuts, tea, etc. to feed and nourish them instead of escaping to the surface and being lost by evaporation.

Such methods would lessen the "change of leaf," which discourages, if it does not actually prevent, cacao and other trees from forming their fruit, as it saps its energy, which is (quite needlessly, I would claim) diverted to throw out fresh leaves. This causes the crop of fruit to be reduced, and what does come to be of inferior quality, being less nourished.

Manuring, therefore, ameliorates drought conditions, and in this term I include the use of estate refuse, stable and pen manure, mulching, etc.; but in all cases precautions must be taken to prevent pests breeding in the compost and spreading trouble around. This can be avoided by mixing a little kainit with the manure, since this fertilizer acts as an insecticide as well as a plant food.

Taking for granted that you have the moisture safely tucked away under the top soil, you may still want to apply fertilizers to feed the tree and help it fight the drought. In this case apply it as much as possible, in such a manner as to still keep the roots well down in the deeper, cooler, moister subsoil away from the dryness and heat of the surface. In TROPICAL LIFE for June, 1913 (pp. 113-114), I discussed the possibilities of attaining your

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* DRY-FARMING, A SYSTEM OF AGRICULTURE FOR COUNTRIES UNDER A LOW RAINFALL. By JOHN A. WIDTSOE. Crown 8vo. 7*s.* 6*d.* post free. TROPICAL LIFE Publishing Department.

desire to do so by planting the trees wide enough apart to apply the fertilizers, especially nitrate of soda, which attracts moisture, and give almost immediate results by means of rather deeply set drills following a cultivating hoe, and being followed, perhaps, in their turn by disc harrows or clod rollers, or other cultivating implement to form an even dust mulch to cover in the holes, and at the same time pressing this home to the desired firmness.*

There always has been, and still is, a tendency in the Tropics to plant too closely. I have always maintained, on the contrary, that you want to plant wide—that is, remember, as wide as you can, so long as you do not expose your soil to the scorching sun and cause it to crack and the trees to wither, to give no crop, perhaps to die. To-day, thanks to the training and publications of the various Agricultural Departments that both the United States and Great Britain have 'dotted' about their Colonies, and thanks especially to what you 'dry-farmers' have taught us, we have learnt many wrinkles of how to plant wide and still keep the ground moist, cool, and well aerated so as to give the trees those three necessities of life, water, food, air, without which they can no more live than you or I. The result is that, nstead of talking of planting up estates at 6 × 6, 9 × 9, 12 × 12, 15 × 15, and so on, we have, with the latest books to guide us, already reached 30 × 30, or 48 to the acre, and the sooner that such distances are generally adopted—that is, on the flat lands—the better for the trees and the pockets of the planter as well as for the manufacturer, since the less strenuous struggle for existence gives the latter a better article with a lower percentage of shell and waste. It is only by such means, i.e., by scientific drainage (to divert surplus rains and water) and dry-farming methods (to conserve the moisture in times of scarcity) that we can expect regular outputs independent of the elements, or whether the sun shines or the rain rains.

TRANSPIRATION CO-EFFICIENTS OF PLANTS.

N. TOULAIKOFF.

The study of the question of the transpiration coefficients of cultivated plants, viz., of the amount of water necessary to form a unit of dry matter, is part of the chief work of the culture house of the Besentchuk Agricultural Experiment Station, as this is situated in a district of South-East Russia (province of Samara) which suffers greatly from prolonged summer drought and excessive variations in the crops. The experiments were carried out during the five years 1910-1914, in the culture house and in the open, in order to answer the following questions: Is it possible to overcome rapid changes of temperature and great variations in the amount of humidity in the soil and the air by means of cultivating plants possessing great properties of resistance? Is it possible to obtain such a combination of anatomical and physiological characters in a cultivated plant as to ensure, in all circumstances, the maintenance of its highest productive capacity? And, finally, in what relation does the latter stand to its environment?

The pot experiments were begun in 1910 in the culture house, which is protected above by a glass roof and at the sides by wire netting; their number continued to increase so that by 1914 there were 408 pots. A measured volume of water was given to each pot throughout the growing period, so that

* Since I made this suggestion I have been glad to see that several of my contemporaries have supported me in recommending it, especially the idea of applying the fertilizer by means of drills to get it safely tucked away underground.

the daily or seasonal consumption could be calculated. Now, dividing the total amount of water consumed by the plant by the amount of dry matter of the aerial parts of the same plant, we obtain what is commonly known as the transpiration co-efficient. This co-efficient, as shown by experiments, has not a constant value for every plant, but changes within somewhat wide limits from year to year, according to the meteorological conditions of the surroundings and the humidity of the soil in which the plant is growing. For example, on cultivating plants under identical conditions of soil humidity (60 per cent. relative humidity) and with the same amount of nutritive substances, the following transpiration co-efficients were obtained.

	1911.	1912.	1913.	1914.
Wheat var. Poltawka ...	628·4	444·5	338·6	387·6
,, ,, Bieloturka ...	756·3	475·9	316·5	397·1
Oats ,, Giant ...	655·1	510·3	347·4	369·9
Barley ,, Moravian ...	617·9	461·6	230·3	413·3

The year 1911 was excessively dry, while that of 1913, on the contrary, was too rainy; 1912 was an average year and, 1914 rather dry. Comparing the coefficients, it may be said that there is a definite relation between the numerical value of the transpiration coefficient and the humidity of the air.

In order to study the question more thoroughly, experiments were also made with LIVINGSTON's evaporimeter and the results obtained showed, according to the writer, that, as regards the question of the amount of water consumed by a plant in different years, or in different seasons of the same year, the greatest influence is exerted by the external meteorological conditions, and not by the biological character of the plant.

	Bieloturka wheat.	Poltawka wheat.	Moravian barley.	Giant oats.	Common millet.
Humidity of Soil 60 %					
Amount of water evaporated, cc. ...	18·284	18·206	20·840	22·875	14·025
Yield of dry matter (aerial parts) gms.	44·11	41·55	48·00	48·56	44·51
Yield of grain, gms. ...	16·02	15·63	20·41	18·99	20 34
Transpiration coefficient ...	441·4	449·8	439·5	480·5	307·3
Humidity of Soil 40 %					
Amount of water evaporated, cc. ...	10·841	11·401	14·728	12·706	10·704
Yield of dry matter (aerial parts), gms	30·99	28·92	35·14	37·20	37·84
Yield of grain, gms. ...	11·34	12·66	13·63	16·27	15·39
Transpiration coefficient ...	391·0	405·1	434·3	356·4	279·6
*Humidity of Soil 20 %**					
Amount of water evaporated, cc. ...	2·881	3·553	3·296	5·096	4·940
Yield of dry matter (aerial parts) ms	8·50	7·98	8·94	12·28	16·28
Yield of grain, gms. ...	2·85	3·20	2·60	5·06	5·55
Transpiration coefficient ...	457·7	426·4	544·2	652·5	367·1

The accompanying table gives the chief results of the experiments, viz. the averages for the four years 1911-1914, which refer to the amount of water

* The averages of these experiments are for three years (1911, 1912 and 1914).

transpired, the dry matter produced, the amount of grain obtained, and to the coefficients of transpiration under the different conditions of soil humidity, viz. 60, 40 and 20 per cent. of the relative humidity.

Experiments on the transpiration coefficient were also instituted in the open and since the majority agreed with those of the culture house, the writer draws the following conclusions:

1. In studying the conditions of the consumption of soil moisture by different plants in the arid part of the province of Samara, it has been clearly shown that the daily consumption of water on the part of the plant is in intimate relation with the meteorological conditions of the period of growth, and, to be precise, in inverse ratio to the humidity of the air. The plants that have been studied from this point of view (beardless common wheat, bearded durum wheat, oats, barley and millet) do not differ in the course of the daily consumption of water, but only in the absolute amount of water used.

2. The transpiration coefficient is not a constant quantity, but varies from year to year within somewhat wide limits in connection with the external meteorological conditions of the locality and the reserves of soil moisture at the plant's disposal.

3. The experiments carried out in the culture house of the Besentchuk Experiment Station have shown that in the optimum conditions of growth (from the point of view of the content of nutritive substances and of humidity), or approximately in such conditions (where the soil is a little less damp), there is no practical difference between the transpiration coefficients of bearded durum wheat, beardless common wheat and barley, while this coefficient is less for millet and larger for oats.

4. The variations in numerical value of the transpiration coefficient in the case of a given plant (wheat, oats, millet) are not infrequently larger in different years than for different species in the same year.

5. From the attempts to determine the transpiration coefficient in the open, it was found that the said coefficient is twice as large as that determined in the culture house and that its numerical value depends upon meteorological conditions in the same manner as is the case in the experiments carried out under shelter.

6. The numerical value of the transpiration coefficient of summer wheat grown in the open varies very considerably in connection with the date of sowing: early sowing, which under the experimental conditions gives the largest crop, gives the lowest transpiration coefficient, while late sowing greatly increases the coefficient and decreases the crop.

7. The transpiration coefficients of wheat and oats sown in rows are lower than for the same crops broadcasted.

8. According to the experimental data of 1914, the largest crops of summer wheat and oats were always obtained when the amount of water consumed per unit of production was smallest, and vice versa.—BULL. INT. INST. OF AGRIC.

According to an abstract in the MONTHLY BULLETIN, the area under rice in Argentina is about 12,350 acres which yield from 12 to 13,000 tons of rice per annum. Only 5,000 of this is consumed locally. The extension of cultivation is being managed by government and an experiment station for rice growing is about to be established in the province of Buenos Ayres. Usual yields are said to be about 66 bushels per acre.

SOIL BACTERIA.

Soil contains myriads of minute living organisms on whose activity much of the fertility of the soil depends. Without them many of the soil constituents and most manures would be of little avail to plants as it is only by their action that the constituents become available for the nutrition of crops. A cubic centimetre of soil taken from near the surface contains from $1\frac{1}{2}$ to 2 millions of bacteria of many kinds, besides innumerable fungi. Below 5' or 6' few bacteria are to be met with.

Farmyard manure, guanos, cakes, bonemeal, etc., undergo decomposition by their agency and are broken down into simpler chemical compounds which can be absorbed through the root hairs of plants.

To deal with Nitrogen, practically all plants absorb this in the form of Nitrate of Lime or similar salt. This nitrate has been formed by the gradual decomposition of decaying leaves, or other nitrogenous vegetable or animal matter, brought about by the agency of certain putrefactive and other bacteria. By these the proteids are broken down into simpler nitrogenous bodies, and slowly and gradually into compounds of ammonia. The action of different types of bacteria now begins, and the ammonia compounds are oxidised first to nitrous compounds by very minute mobile bacteria belonging to the genus Nitrosomonas and finally to nitric acid by bacteria belonging to the genus Nitrobacter.

The nitric acid as it is formed combines with a base in the soil, usually lime, or with the potash of wood ashes if such have been applied, to form calcium or potassium nitrates, both of which salts are soluble in water and are readily absorbed through the root hairs of plants.

For nitrification to take place several conditions must be fulfilled, otherwise the bacteria cannot act. These are, briefly, a suitable temperature, about 75° F. being best; ample air such as is found in a well-drained soil, sufficient moisture, and the presence of a free base such as lime to combine with the nitric acid as it is produced.

Besides the nitrifying bacteria mentioned above, there are several denitrifying bacteria which act in the reverse way reducing nitrates to nitrites, and these to ammonia and finally to free nitrogen, which escapes into the air and is lost. These are found chiefly in fresh dung and old straw, and can only act under anærobic conditions, i.e. with little or no air, so that on well drained and cultivated land they are of little importance, and can cause but a slight loss of nitrates through their agency.

An important group of soil organisms are now known which have the power of using the free nitrogen of the air to form the complex nitrogenous compounds of which their bodies are largely composed.

By their continued action they gradually enrich the soil with nitrogenous material, which after nitrification becomes available for the use of the higher plants.

The higher plants cannot fix nitrogen, but the *Bacterium clostridium pasteurianum* common in most soils is able to utilise free nitrogen under anærobic conditions and an organism known as *Azotobacter chroococcum* and others closely allied to it can utilise the nitrogen under ærobic conditions.

All these need to be supplied with carbohydrates or other carbon compounds which are contained in humus or plant residues, or in some instances from carbohydrates manufactured by minute green Algæ with which they live in close union.

Among the nitrogen-fixing bacteria, a certain class enter into association with the roots of leguminous plants such as Beans, Peas, Dadaps, Tephrosias, etc.

These bacteria are present in almost all soils and enter the root hairs of their host plants and gradually stimulate the production of a characteristic growth or nodule on the rootlets. These nodules are found to contain large numbers of a bacterium termed *Bacillus radicicola* or *Pseudomonas radicicola*. For a time they multiply, obtaining the necessary nitrogen for their nutrition and growth from the free nitrogen of the air, and the carbohydrates from their host plants.

The nodules increase in size and for a time are rich in nitrogen, which gradually decreases as the organisms are transformed into soluble nitrogenous compounds, which are conducted to the developing roots and tissues of the hosts. After the death of the plants and subsequent decay of the roots some of the unchanged bacteria are left in the soil to infect a new leguminous plant.

These nitrogen-fixing bacteria have been cultivated on artificial media and many attempts have been made to utilize them for practical purposes, by inoculating soils with the special type required by the crop to be grown.

The results are always negative, probably owing to the soil already containing the particular organism in abundance.

Applications of more or less pure cultivations of bacteria of the azotobacter group have been made to poor soils in order to provide a cheap supply of nitrogen, but such applications are still in the experimental stage.

In Ceylon and the East generally the advantages of the azotobacter group of nitrogen-fixing bacteria have been utilised on a large scale for many years. First for the improvement of tea in Assam by the growth of the San tree *Albizzia stipulata* as a green manure, and later by the growth of numerous herbaceous and tree form leguminous plants such as Crotalarias, Tephrosias and Phaseolus species, and Erythrina, Albizzia and Acacias amongst the tea, rubber, cocoa and other tropical products in Ceylon.

All the plants utilised on a practical scale at the various elevations in Ceylon are known to develop nodules to a greater or less extent, according to the type of soil and the assistance given to the plants by cultivation and manuring of the products amongst which they are grown. In old, worn out soils from which the surface soil had long been removed by wash it was often difficult to establish any form of green manuring, probably partly due to the almost complete absence of the special bacteria required, and for crotalaria the addition of a little soil from where the species grew luxuriantly was found very successful.

In the case of Dadaps, a brief form of propagating this plant is gradually being established at higher elevations and in most unpromising soils by first planting them in sheltered ravines, allowing them to grow into trees and utilising the branches for cuttings, which can be planted immediately, before fermentation has set in. Here the bacteria are not required for the establishing of the plants, but in all cases examined they appear later and assist in the production of a large amount of green organic material for the subsequent benefit of the tea or other product concerned.

These green manuring crops during their growth compete with the main product for the moisture and mineral matter required for their growth, also to a certain extent for their nitrogen requirements. Leguminous plants, however, obtain much of their nitrogen from the air in the manner described, a feat impossible to ordinary plants. The decay of the branches and leaves after lopping therefore add to the soil a large amount of nitrogen, which with the carbohydrates and cellular matter is gradually changed into humus by the putrefactive bacteria, and the proteid bodies are slowly converted into ammonia compounds and these into nitrites and nitrates, which are then directly assimilable by ordinary plants.

M. KELWAY BAMBER.

"HUMOGEN," OR BACTERISED PEAT.

A telegram appeared in the local press of the 3rd instant stating that the Board of Agriculture has agreed to assist experiments on a large scale with a view to ascertaining the possibilities of Humogen, otherwise bacterised peat, as a fertiliser, discovered by PROFESSOR BOTTOMLEY of King's College. Some authorities believe Humogen could double the food supply.

In a leading article in the OBSERVER of the 5th instant the process is described as one of three stages.

1st.—Crude peat is acted on by certain bacteria and quantities of humates are liberated.

2nd.—The humated peat is sterilised by heat.

3rd.—It is treated with a mixed culture of nitrogen-fixing bacteria.

It is claimed that the sterilised humated peat encourages in a marked manner the activities of the nitrogen-fixing organisms, so that the amount of soluble nitrogen compounds is increased during the third stage of the process.

It is also stated that extremely small quantities of a watery extract of bacterised peat are potent stimulators of plant growth and that the peat is 50 times more valuable than any manure now in general use.

The effect is ascribed not so much to an increase of plant food, as the amount in the watery extract employed in the experiments was minute, but to the presence of some unknown substance, which apparently acts as a strong tonic in stimulating and accelerating growth.

PROFESSOR BOTTOMLEY recently lectured at the Royal Botanic Gardens, Regent's Park, on his investigations and discovery, and no doubt further evidence of the advantages of his discovery will be forthcoming other than the box of healthy looking potatoes said to have been grown in 7½ weeks simply by being watered with an extract of bacterised peat.

A cultivation of nitrogen-fixing bacteria for soil inoculation was brought out some years ago that was going to revolutionise agriculture, but it has not yet materialised, although the following experimental evidence is clear.

1st.—Soil inoculation has proved successful on poor virgin soils that are being put under leguminous plants for the first time.

2nd.—It has also succeeded on older arable land, when a completely new variety of leguminous crop is being grown for the first time.

3rd.—For ordinary leguminous crops that have been grown fairly frequently on the same soil successful results have been so rare that the plan has not been adopted to any extent.

If the results of PROFESSOR BOTTOMLEY's investigations are confirmed by the new experiments under the Board of Agriculture they will certainly be of great importance and similar experiments will no doubt be carried out in Ceylon with the bacterised peat to prove its value for tropical and semi-tropical products.

M. KELWAY BAMBER.

CACAO AT THE EXPERIMENT STATION, PERADENIYA.

The cacao plots at the Government Experiment Station, Peradeniya, are looking well as the result of careful attention to cultivation, manuring and plant-sanitation. The removal of excess of shade and the systematic excision of cankered bark have greatly improved the health of the trees. The cutting-out of diseased bark is now being done on improved lines which ensure quicker healing of the wound and do not leave an unsightly scar. To check the spread of the fungus among the pods, picking is being done every fortnight. Forking and liming also help to keep the soil well ærated and sweet. The illustration accompanying this Note shows a fine crop of cacao at the Experiment Station.

Photo by H. F. Macmillan.

CACAO HARVEST AT THE EXPERIMENT STATION, PERADENIYA.

POTATO DISEASE.

(PHYTOPHTHORA INFESTANS.)

This is the subject of a useful leaflet issued by the Board of Agriculture and Fisheries, England.

The first signs of the disease are yellow spots on the leaves. These .ncrease in size and become brown and the leaves begin to curl. Under the leaf will be found a delicate white mould, which represents the fruiting part of the fungus and contains spores which help to spread the disease.

The disease as it occurs in the leaves gradually travels down the stem and into the tubers.

As soon as the disease appears, cut and remove all affected plants leaving the tubers if already formed, but these too should be lifted as soon as practicable.

Store tubers in a clean, dry place. Exclude all diseased and damaged tubers. Seed tubers should be stored in boxes separate from the rest.

Where disease inclines to persist a change of seed from a perfectly healthy crop should be obtained.

LARGEST TREES IN THE UNITED STATES.

The JOURNAL OF HEREDITY for September devotes an article to this subject and gives some interesting records of the largest broad-leaved trees.

The largest tree in the States (excluding conifers) appears to be an American plant (*Plantanus occidentalis*) at Worthington, Indiana, measuring 42 feet in girth 5 ft. from the ground and dividing at 12 ft. into two stems 27 ft. 8 in. and 23 ft. 2 in in girth, the total height being 150 ft.

In the same district another tree of this species 67 ft. in girth is known to have been felled.

A Tulip tree (*Liriodendron tulipifera*) near Asheville, N. Carolina, is 198 ft. high with a girth of 34½ ft. at 4 ft.

Of Elms (*Ulmus americana*), the largest reported is the Manchester Elm of Massachusetts, 105 ft. in height and 24 ft. in girth at 5 ft.

The largest oak (*Quercus lobata*) in America is in San Benito country, California, 125 ft. high and 37½ ft. in girth.

An American Chestnut (*Castania dentata*) at Chestmont, North Carolina, is 75 ft. high and 33 ft. in girth at 7 ft.

Other records are a Pecan (*Hickoria pecan*) 150 ft. high and 19½ ft. in girth near Bermuda, Louisiana ; a *Catalpa speciosa*, 75 ft. high and 16 ft. in girth at Luxora, Arkansas ; a Sassafras at Horsham near Philadelphia 15 ft. 10 in. in girth ; and a black walnut 24 ft. in girth at Hanover Neck, New Jersey.

The source of Chinese wood oil (to which the BULLETIN OF THE IMPERIAL INSTITUTE VOL. XI. No. 3 devotes an article) is *Aleurites Fordii*, though a small amount is also obtained from *A. montana*. The PHILIPPINE JOURNAL OF SCIENCE mentions that in 1911 the United States imported 5 million gallons of the oil from China. The oil is used extensively for varnishes, linoleum and similar purposes in America, and so highly is it appreciated that 40,000 trees have been planted in the Southern States. These are expected to furnish one-fourth to one-third of the present supply of imported oil. In Ceylon *Aleurites triloba* (Sinh. Tel Kekuna), which is widely spread over the moist region of the Island, furnishes a drying oil of very similar properties.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10 a £8 12 6
,, unbleached ,,	Dark to good genuine	£6 5 a £7
,, Madagascar ,,	Dark to good palish	£7 15 a £8 2 6
CAMPHOR, Japan lb.	Refined	1/7 a 1 8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6
per lb.	Middling lean	4/8 a 5 4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5 3
Mangalore ,,	Med Brown to good bold	4/ a 6 4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6 4
Malabar ,,	Fair to good	3 2 a 3 4
Seeds, E. I. & Ceylon ,,	Fair to good	4/ a 4 3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3 6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60
Japan ,,	Fair bright small	60/ a 70
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1 9
per lb. 2nds.	,, ,,	1/2 a 1 7
3rds.	,, ,,	1/1 a 1 6
4ths.	,, ,,	1/ a 1 3
Chips,	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1 2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅞d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63 a 80
COCOA, Ceylon Plant. ,,	Special Marks	81 a 88 6
	Red to good	73 a 80 6
Native Estate ,,	Ordinary to red	42 a 68
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15 a 22 6
CROTON SEEDS, sifted,,	Dull to fair	42 6 a 47 6
CUBEBS ,, ,,	Ord. stalky to good	130 a 150
GINGER, Bengal, rough ,,	Fair	19
Calicut, Cut A ,,	Medium to fine bold	75 a 85
B & C ,,	Small and medium	35 a 74
Cochin, Rough ,,	Common to fine bold	22 6 a 27
	Small and D's	20
Japan ,,	Unsplit	20
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40 s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10 a £16 10
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70 a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10 a £7 5
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26 a 32 6
Turkey sorts ,,	,, ,,	37 a 57 6
Ghatti ,,	Sorts to fine pale	17 a 27
Kurrachee ,,	Reddish to good pale	22 6 a 32 6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15 a 27 6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2 4
	Crepe ordinary to fine	2 2
Ceylon, Straits, ,,	Fine Block	2 4
Malay Straits, etc. ,,	Scrap fair to fine	1 8 a 1 9
Assam ,,	Plantation	1 10
,,	Fair 11 to ord. red No. 1.	1 3 a 1 6
Rangoon ,,	,, ,, ,,	1 2 a 1 4

	QUALITY.	QUOTATIONS
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1 4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2/
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1 2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1 11 a 2 9
MACE, Bombay & Penang	Pale reddish to fine	2 4 a 2 6
per lb.	Ordinary to fair	2 a 2 2
Java	,, ,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5 2
CASSIA ,,	According to analysis	2 8 a 2 11
LEMONGRASS oz.	Good flavour & colour	2¼d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1 6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10 6
Madagascar ,,	Fair	10 6
Zanzibar ,,	Fair	10 6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅝d
Singapore ...	Fair	4⅞d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8¾d
Siam ,,	Fair	8½d
Penang ,,	Fair	7⅜d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1.10 a 3/6
High Dried,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large--cwt	Fair to fine	18
medium ...	,, ,,	16/
small ...	,, ,,	13/ a 14/
Flour ...	Good pinky to white	10/ a 11/
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6

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Superintendent of Botanic Gardens, Ceylon.

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